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The HOME FRUIT
GARDEN ON THE
NORTHERN
GREAT PLAINS



COLD AND DROUGHT make fruit growing difficult and consequently limit fruit production on the northern Great Plains; but if a suitable site is chosen, hardy varieties planted, and the plants given proper care, a farmer in this area should be well repaid for his efforts to grow fruit for home use.

In most locations the protection of a shelter belt is essential to success.

The land should be well prepared, preferably by fallowing, so that planting may be done in moist soil.

First-class stock of hardy varieties from northern nurseries should be used. For the tree fruits 1-year-old or 2-year-old trees should be planted and low-headed or, in some cases, bush-form trees developed.

Cultivation, pruning, spraying, protection from rabbits and mice, and winter protection are essential.

The hardier varieties of apples, crabs, plums, plum \times sand-cherry hybrids, sand cherries, June berries, currants, gooseberries, raspberries, strawberries, native fruits, and perhaps a few of the hardier varieties of grapes can be grown with a greater or less degree of success, depending on the district, site, and care given.

Peaches, pears, apricots, cherries, blackberries, dewberries, and nuts are not generally hardy, and their planting can not be advised.

THE HOME FRUIT GARDEN ON THE NORTHERN GREAT PLAINS¹

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INTRODUCTION

THE ESTABLISHMENT of fruit gardens on the northern Great Plains has been slow and meager. It has been limited by the climate and by a lack of knowledge of hardy varieties and of cultural methods adapted to the section. Too many homes are without surrounding shelter belts, shrubs, flowers, and fruits, all of which help so much to make the farm in any region an attractive place to live. Such plants are of special importance to the farmer on the Plains, where most of the area is devoid of natural tree growth, winds are often severe, and fruits are scarce.

The value of the home fruit garden on the northern Plains is far greater than can be measured by its return in dollars and cents. There is a pleasure and satisfaction in growing good fruit and picking it as it ripens in one's own garden that can not be obtained by buying the same product in the store. Moreover, the market supply of fresh fruit is often limited and the price high, so the Plains farmer who depends on buying his fruit generally has less of it on the table than he should have both for health and for the pleasure of a mixed diet. A liberal supply of fruit in the diet is decidedly beneficial. The fruit garden is an ornament to the farm, increases the value of the land, reduces grocery bills, and in favorable years may even add to the farm income, as any surplus should find a local market in this section where the supply of native-grown fruit is limited.

Commercial fruit growing probably will never be of great importance on the northern Plains. There are doubtless opportunities for farmers having experience and unusually favorable sites to grow

¹ The information contained in this bulletin is based largely upon the results obtained at the United States Northern Great Plains Field Station, Mandan, N. Dak.

fruits and vegetables for sale in local markets and to profit financially thereby, but this aspect of fruit growing is not considered in this bulletin. The problem of growing fruit for home use and its relation to the building of more permanent and more attractive homes on the northern Plains is believed to be of far greater importance than any commercial fruit problem of the section.

That it is possible to grow fruit for home use in most of this section can no longer be doubted. Experience has shown that it is not easy, but fruit growing requires careful attention in any region if best results are to be obtained. This is especially true of the northern Plains, where climatic factors make fruit growing particularly difficult. However, many persons have been determined to grow fruit and when overtaken by failure have been willing to learn and to try again, until they have achieved success. The experience of such men

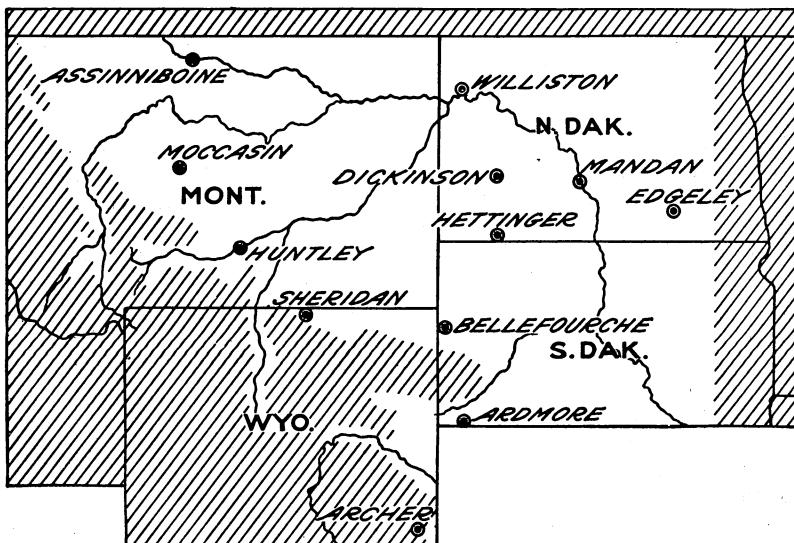


FIG. 1.—Map of the northern Great Plains. The location of each field station of the Office of Dry-Land Agriculture within the section is shown by a dot within a circle

and the results of work at State and Federal agricultural experiment stations clearly indicate that, given a suitable site, adequate protection from wind, hardy varieties on hardy roots, and cultural methods adapted to the section, the farmers on the northern Plains can grow good fruit both to eat out of hand and for culinary purposes.

AREA AND TOPOGRAPHY

The northern section of the Great Plains, to which this bulletin applies, includes roughly the portions of North Dakota and South Dakota west of the one hundredth meridian and the Plains sections of Montana and Wyoming east of the Rocky Mountains. (Fig. 1.)

Except for the Bad Land districts, river valleys, occasional hills, and a few isolated groups of small mountains, the section is largely characterized by broad, rolling, treeless plains. Most of the section

is drained by the Missouri River and its tributaries. The Mouse River drains a portion of it in northern North Dakota. Over much of the section there is a gradual rise in elevation from the east to the west and also as the distance increases away from the valleys of the Missouri and Yellowstone Rivers. Altitudes of 1,500 feet are common near the Missouri River in South Dakota, but the elevation rises to 5,000 feet or more as the foothills of the Rocky Mountains are approached.

CLIMATIC FEATURES²

The climate of the northern Great Plains has been classed as semi-arid, although variable from year to year in both the amount and distribution of the annual and seasonal precipitation. In general, the average annual precipitation decreases from east to west, ranging from 15 to 20 inches over most of the western parts of the Dakotas, and from 10 to 15 inches over much of the Plains sections of Montana and Wyoming. Exceptions occur, as in the Black Hills, which is a district of comparatively heavier rainfall.

The type of precipitation on the northern Plains is characterized by comparatively heavy rains in late spring and early summer and a light precipitation in fall and winter. On an average, almost 50 per cent of the annual precipitation falls in the three months of May, June, and July, and the seasonal precipitation from April 1 to September 30, inclusive, ranges from 60 to more than 80 per cent of the annual, being approximately three-fourths of the annual precipitation over much of the territory. June is generally the month of heaviest precipitation.

The seasonal evaporation from April 1 to September 30, inclusive, from a free water surface varies from about 32 or 33 inches near the Canadian border to 38 or 39 inches near the South Dakota-Nebraska boundary line.

This section of the Great Plains is subject to severe drying winds at all seasons of the year. March, April, and May are generally the more windy months. The prevailing wind direction is from the west or northwest over a large part of the area. South winds during the summer are sometimes hot and dry, and consequently very trying to horticultural plants.

The average date of the last killing frost in the spring varies from May 1 to May 31 in different parts of the northern Great Plains, and the average date of the first killing frost in the fall varies from September 1 to September 30. Thus the average length of the frost-free period ranges from about 90 to 150 days. In most of western South Dakota and in districts close to the Missouri or Yellowstone Rivers in North Dakota and Montana, the average frost-free period generally ranges from 120 to 150 days, whereas in other parts of the northern Plains an average frost-free period of only 90 to 120 days generally obtains. As a rule, the length of the growing season decreases with increases in altitude, and to some extent from south to north.

² This brief characterization of the climatic features of the section is largely adapted from the following:

KINCER, J. B. PRECIPITATION AND HUMIDITY. U. S. Dept. Agr., *Atlas Amer. Agr.*, pt. 2, sec. A, 48 pp., illus. 1922.

REED, W. G. FROST AND THE GROWING SEASON. U. S. Dept. Agr., *Atlas Amer. Agr.*, pt. 2, sec. I, 12 pp., illus. 1918.

This section is characterized by long, cold winters and short, warm summers. Winter temperatures of -40° F. or more have been recorded at most Weather Bureau stations located on the northern Plains, and summer temperatures of 100° F. or more may be expected, except at the higher elevations, where lower summer temperatures and cooler nights prevail.

Some climatic factors that tend to make fruit growing especially difficult are—

Low annual precipitation and uncertain periods of drought.

Long, cold winter.

Strong, drying winds which may occur at any season of the year.

Dry atmosphere and a high rate of summer evaporation.

Comparatively short growing seasons, with the possibility of damaging frosts either in late spring or early fall.

Sudden changes of temperature, especially in the winter, and alternate freezing and thawing in the spring.

Light snow covering during the winter.

Occasional hail.

These adverse climatic factors may occur in many different combinations. Their combined effect is to make the northern Great Plains one of the most trying sections in the United States for fruits. Winterkilling probably often results from a combination of drying, cold, and other factors rather than from low temperature alone. Young trees that have not become well established are especially subject to such winter injury. Older trees that have been weakened by drought, competition with other plants, insects, diseases, over-bearing, or mechanical injuries often are unable to survive the cold winters and drying winds.

However, not all the climatic conditions are adverse. Fungous diseases and some insect pests are not so likely to be troublesome as in more humid regions. The clear skies and bright sunshine may cause sun scald on the southwest side of a tree during the winter and early spring, but they hasten the ripening of the fruit during the short growing season and give it a desirable color. Some fruits, such as currants and gooseberries, do not thrive in the hot climate of southern latitudes but flourish in the cooler climate of the North. Other fruits, such as sand cherries, are not adapted to humid regions but thrive in the dry atmosphere of the Plains. The obvious thing to do is to select those fruits that are at least in some degree adapted to the climatic conditions that obtain and not attempt to grow fruits that lack hardiness or the ability to withstand periods of drought.

SELECTION OF SITE

The selection of a site for the home fruit garden is of fundamental importance. If possible, it should be close to the farm buildings for convenience in properly caring for it and gathering the fruit, also because it adds to the attractiveness of the home. But if the buildings are on very poor, rocky, or alkaline soil, on the top of an exposed hill, on a steep south slope, or in a hollow or depression in which cold air is liable to settle, it would be better to select some other place on the farm where the soil and exposure are better suited to fruit growing.

Occasionally the site may be chosen to utilize run-off waters from higher ground during heavy rains. Furrows aid in diverting such

flood waters to the selected site, but if the slope is too steep, washing of the soil may occur.

Comparatively level land may be used for the fruit garden. A very steep slope should be avoided, as cultural operations on it become difficult and washing of the soil is liable to occur. If irrigation is contemplated, it is especially desirable to select land that is fairly level, as it is very difficult properly to irrigate rolling or uneven land and steep slopes.

A north or northeast slope is to be preferred. On such a slope trees bloom later in the spring than on a decided south slope, thus tending to escape late spring frosts; furthermore, trees and ground are not so subject to alternate freezing and thawing in the spring; a snow cover remains on the ground, protecting the roots for a longer period; there is better protection from drying south winds in the summer; and the trees are less exposed in winter and early spring to the bright afternoon sun, which so often causes sun scald and ultimate death. Evaporation is greater from a south than from a north slope, so, although each receives an equal rainfall, plantings on the south slope are more subject to injury from drought. Native vegetation indicates the advantage of a north slope, as hills often have trees and brush on the north side while only grass is found on the drier southern aspect.

Good air drainage is necessary, and fruit trees should never be planted in a hollow or pocket from which cold air can not drain away to lower levels. Generally speaking, trees on the higher lands of a locality have a better chance of escaping frost damage in late spring or early fall than trees on the lower lands; but this does not mean that fruit trees should be planted on the tops of exposed hills. A well-drained coulee would be much better, as it would afford a certain amount of protection from wind, catch more snow during the winter, and supply more water. (Fig. 2.)

The soil should also be considered in selecting the site for the home fruit garden, although fruit trees and small fruits adapt themselves to a fairly wide range of soils and generally will succeed on land that is fit for general farming. A well-drained, fairly rich loam or sandy loam from 6 to 8 feet in depth would be ideal, but either the more sandy or the heavier soil types will produce good fruit. Shallow soils less than 2 feet in depth, soils underlaid with coarse gravel, rocky land, and alkaline soils should be avoided.

PROTECTION FROM WIND

The fruit garden on the northern Plains will thrive largely in proportion to the extent to which it is protected from wind. This protection may be in the form of natural hills or mountain ranges, native timber, buildings, or trees planted for shelter belts. One of the most striking things observed in the horticulture of the section is that wherever successful fruit growing is found there is also found adequate protection from wind. If natural protection is not available—and it is not available to the great majority of Plains farmers—shelter belts should be planted and grown to a height of at least 5 or 6 feet before fruit growing is attempted. (Fig. 3.)

Experience indicates that over much of the section protection from the prevailing west winds is most important and that next in

importance is protection from the hot, drying, south winds of summer. There should be protection also from the cold, drying, north winds of winter. Protection on the east is probably of least importance. Shelter on all sides may obstruct air circulation and by creating an artificial air pocket render the plants more liable to frost injury, but such damage is improbable.

A good shelter belt protects the fruit garden from drying winds throughout the year; it prevents fruit from being blown off and limbs and foliage from being broken and lashed about by the wind; the calmer air encourages bees and other insects, which are so essential to pollination, to work freely at blooming time; and it aids in collecting and holding an even cover of snow, thus protecting the roots during the winter. The shelter belt is on duty protecting the



FIG. 2.—Part of an orchard planted in a coulee at the United States Northern Great Plains Field Station, Mandan, N. Dak. Photographed in July, 1925, when 5 years old

fruit garden at all seasons of the year, and it is almost useless to consider fruit growing on the Plains without such shelter.

The shelter belt ordinarily should present a width of about 10 rows of trees, the rows being spaced 10 or 12 feet apart and, except for Siberian pea tree (*Caragana arborescens*), the trees planted about 6 feet apart in the row. A combination of several kinds of trees is more desirable than a solid planting of one species. The following arrangement is suggested for a 10-row shelter belt, starting with row 1 at the outside of the shelter belt (farthest from the orchard) and ending with row 10 on the inside of the shelter belt (nearest the orchard). Trees having a low branching habit are desirable for the outside row, and the Siberian pea tree is one of the best of this type. The trees in this row should be planted about 3 feet apart. Row 2 may be Russian olive; row 3, box elder; row 4, northwest poplar or

cottonwood; row 5, box elder; rows 6, 7, 8, and 9, green ash or white elm; and row 10, Siberian pea tree or some native fruit such as wild plum, chokecherry, or buffalo berry.

A few rows of evergreens are very desirable on the inside of the shelter belt next to the orchard or buildings. Scotch pine, jack pine, Colorado blue spruce, and Black Hills spruce are considered the hardiest and best evergreens for this purpose. If there is room for only 10 rows of trees and evergreens are desired, they may be substituted for the last three or four rows of green ash or white elm and the row of Siberian pea tree on the inside of the shelter belt.

A snow trap is sometimes advised, to prevent snow from piling up within the shelter belt and orchard and breaking the trees. If the shelter belt contains at least 10 rows and the fruit trees are planted

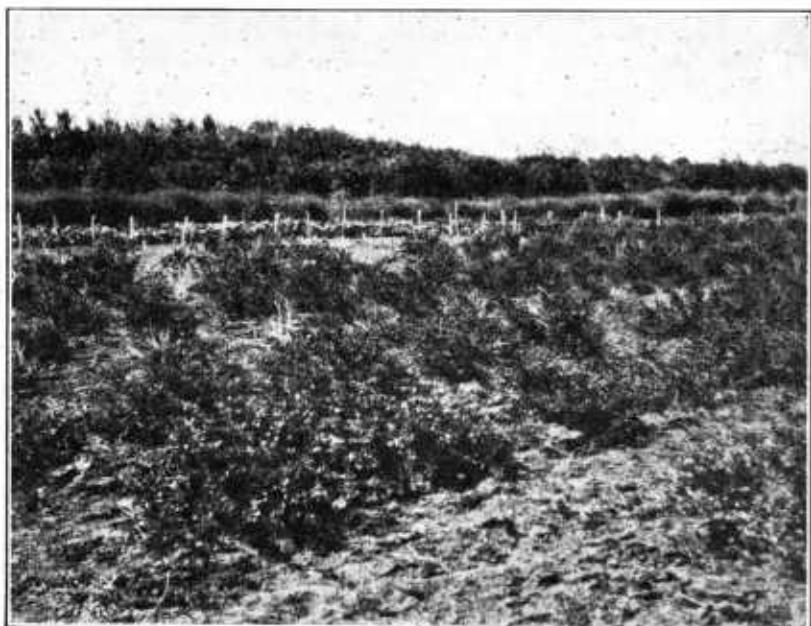


FIG. 3.—A shelter belt protecting a small-fruit garden from west winds at the Northern Great Plains Field Station

30 feet or more from the shelter belt, the heavier drifts of snow will accumulate within the shelter belt and in the space between it and the fruit trees. If a snow trap is desired, one or two rows of trees about 50 feet from the shelter belt on the side from which the prevailing winter winds come should serve this purpose. A row of Siberian pea tree and one of box elder or Russian olive are recommended for the snow trap.

CULTURAL METHODS

Fruit trees and bushes require care and attention wherever they are successfully grown, and cultural methods become of particular importance on the northern Plains where the climatic conditions are adverse. The results depend largely on the care given, especially to

trees when they are young. Many problems are yet to be solved, and the best cultural practice for one district may not always be the best for a neighboring district, or the best cultural practices for one season may not be the best for another. It is obviously impossible to give complete directions that will fit all conditions and varying seasons, but it is believed that the following general directions will be of help in taking care of the home fruit garden. Recommendations are to a large extent based on experimental work conducted at the United States Northern Great Plains Field Station, near Mandan, N. Dak., and on observations made on trips through the area.

PREPARATION OF GROUND

Half an acre to an acre of ground will generally be found sufficient for the home fruit garden. The land should be properly prepared for planting. Never plant on newly broken sod. It is best to crop such land for a year and then to fallow it for a year before planting fruit trees and bushes. It is not considered advisable to plant after a grain crop. Either cultivated crops, such as corn or potatoes, or preferably a year of clean summer fallow should precede planting, as the stand and growth of the young trees and bushes will depend largely on the supply of water in the soil at planting time.

Summer fallow during the year before the nursery stock is planted is the best tillage method for preparing land in the Great Plains. If properly handled it will store needed water in the soil and at the same time effectively kill out grass and weeds. Fallow should be plowed in the spring before the first of June. It should be harrowed as soon as plowing is completed and then cultivated during the entire growing season as often as necessary to keep the land free from weeds. A shovel or duck-foot cultivator is the best type of implement for the cultivation of fallow. The surface should be roughened by a cultivation late in the fall to aid in holding snow and to lessen soil blowing. The fallow should not be plowed again, as a firm, well-settled soil is best for planting nursery stock.

If the proposed site was cropped during the summer preceding the planting of the fruit garden, it should be plowed to a depth of 7 or 8 inches soon after the crop is harvested. The land should then be left rough over winter, as the rough surface protects the soil from blowing and tends to catch and hold drifting snow. If the land starts to blow in early spring, it should be worked with some form of shovel cultivator which will leave the surface in a rough, granular, or ridged condition.

A heavy dressing of well-rotted manure may be turned under at the time of plowing and would be especially desirable for light sandy land, heavy clay, or any soil lacking in fertility. However, this is not necessary for most of the fertile soils of the Plains, where drought, cold, and wind, rather than the lack of plant food, are the factors limiting growth.

As an additional measure for holding snow and supplying water for the future trees and bushes, it is sometimes advisable to plow furrows along the lines where the rows will be or even to dig holes for the trees in the fall. The furrows or holes may be filled with snow and the surrounding ground be well moistened and in good condition for planting when it melts in the spring. Furrows should

not be run in the direction of the land slope, as washing is liable to occur.

ORDERING AND CARE OF NURSERY STOCK

It is advisable for prospective fruit growers on the northern Plains to obtain their planting stock from reliable nurseries situated in or near the district in which they live. Shipping charges are then less, the stock is more likely to arrive in good condition because of the shorter time on the road, and such nurseries are more likely to list hardy varieties suited to the district and propagated on hardy roots. Upon request a list of nurserymen will be supplied by the United States Northern Great Plains Field Station, Mandan, N. Dak. Stock always should be planted while it is perfectly dormant, that is before the buds start to swell or the leaves to form. There is liable to be more trouble with southern-grown stock starting into growth before the land in the North is ready for planting than would be the case with northern-grown stock.

Nursery stock may be ordered for either spring or fall delivery, but if shipped in the fall it should reach the farm before the ground freezes, so that it may be properly heeled in for the winter. The more common method is to order in fall or early winter for delivery in early spring, generally some time in April.

First-class trees only should be purchased. Such trees are not necessarily the largest, but should be medium-sized, thrifty, and free from disease. Well-developed root systems should be insisted upon. Never buy small, weak, stunted, or diseased trees, no matter how attractive the price.

As a rule, 1-year-old trees are to be preferred to 2-year-old trees. They are cheaper, as good or better stands are usually obtained, and there is a better chance to form the heads low and to train the trees as desired. Two-year-old trees are often trimmed up by the nurserymen, so that it is very difficult to develop from them the low-headed or bush-type tree recommended for the Plains.

Shipments of nursery stock should be made by express or parcel post rather than by freight. Freight shipments often are so long on the road that the roots dry out. The shipment should be called for promptly and should be inspected as soon as the farm is reached. If the roots or twigs appear dry, they may be freshened by soaking for a day in a barrel of water placed in a shady place or by completely covering the tree or plant with moist earth. Any trees with the wartlike growths called "crown galls" on the roots should be discarded. Be careful not to let the roots dry out while the stock is being handled. It should be promptly heeled in in a well-drained cool place, as on the north side of a building, until planting time.

To heel in trees, a trench with one sloping side is dug deep enough to admit the roots. The trees are then laid down at right angles to the trench, with the roots in the trench and the tops near the ground on the sloping side, taking care first to separate the trees in the bundle, so that fine, moist soil may be thoroughly worked around all the roots. After packing the soil around the roots the ground may be well watered as a further precaution against drying out, and then more soil thrown on until the roots are covered to a depth of several inches. If the trees are likely to remain heeled in for a considerable

time, especially if they are buried in the fall to remain over winter, the tops should also be covered with moist soil. Care should be taken that the soil around the roots does not dry out at any time, but it should not be water-logged. Trees are left heeled in until planting time, but they should be planted before the buds start to grow. Shrubs, vines, and bushes are treated the same as trees.

PLANTING

It is especially important that trees be planted very carefully on the northern Plains, because much depends on their starting growth promptly and making a fairly vigorous growth during the first summer. Trees that are carelessly planted dry out and often fail to grow; or if they start growth it is usually very late in the season, a weak growth is made during the summer, and they are very susceptible to winter injury.

Spring is the best time to plant nursery stock on the northern Plains. If planted in the fall it is likely to dry out and winterkill during the long, cold winter. The first part of May is probably the best planting time over most of the area, but in districts having comparatively low altitudes and in early seasons it will often be advantageous to plant in the latter part of April.

It is important in planting to see that the roots are always kept moist and not at any time exposed to the drying action of sun or wind. The roots may be wrapped in wet burlap while being handled in the field, or they may be puddled by dipping in a thin mud made of a mixture of clay and water, which effectively prevents drying if not too long exposed. Some prefer to take the stock to the field with the roots in a barrel of water or thin mud.

The holes should be dug wide enough to admit the roots freely without bending or crowding and deep enough to allow planting trees 3 or 4 inches deeper than they stood in the nursery row.

It is commonly advised to trim the roots carefully, but experiments indicate that this is not of great importance. Any unusually long root may be shortened, and if fine roots are numerous enough to interfere with the proper packing of the soil among them some may be thinned out. Large masses of fine roots indicate a disease called "hairy root," and trees showing such symptoms should be discarded. Trees should have good, vigorous roots, and ordinarily but little thinning out or root trimming is necessary. Broken ends of roots may be cut off smooth if desired.

Leaning trees slightly to the southwest is desirable, as the trunk is then less exposed to the afternoon sun, which often causes sun scald or killing of the bark on the southwest side of the tree. Some persons also advocate leaning the tree slightly toward the prevailing wind.

The most important detail of planting is to see that fine moist soil comes in close contact with all roots and that it is packed firmly around them so that large air spaces are eliminated. The first few shovelfuls are best packed under and around the roots with the hands, and after that the feet may be used to advantage in packing the soil as it is thrown in. Do not throw the soil in loosely and merely pack the top, but pack it firmly as it is thrown in, being careful not to break or bruise the roots.

Unless the soil has ample moisture, the trees should be well watered at planting time. Leave or make a shallow trench large enough to receive a bucket of water around each newly planted tree. After the water soaks in, the trench should be filled with loose soil. If planting is followed by several weeks of dry weather it may be necessary to water again, following the same method. Everything should be done to encourage the tree to start growth quickly and to become well established the first summer.

Small fruits are planted much the same as trees, except, of course, that the holes are smaller to correspond to the size of the root system. Bushes are planted a little deeper than they stood in the nursery. Strawberries should be planted at the same depth they formerly grew. The same care is necessary to prevent the roots from drying out, and because of their shallower root system it is even more important to water well at planting time and to repeat the operation as needed until the plants become well established.

All fruit trees should be cut back when planted. If the trees are 1-year-old whips, they should be cut back to 20 or 30 inches from the ground. If 2-year-old trees or well-branched 1-year-old trees are planted, the branches that are to form the framework of the tree should be cut back to within 8 to 12 inches of the main stem and all other branches removed. Suggestions for selecting the main branches are given under "Pruning the young tree," on pages 18 to 20.

Small fruits also should be cut back at planting time, as the top of the plant should be reduced to correspond to the loss of a large part of the root system. All blossom buds and part of the leaves should be removed from strawberry plants.

SPACING

There is little experimental evidence to determine the best spacing of fruit trees on the Great Plains. If the trees are widely spaced each has a large area of soil from which its roots can draw moisture, and if they are closely spaced in groups or hedgerows they protect one another and hold snow. Perhaps each system has its place, and no rule can be laid down that will be best for all conditions. Spacing experiments are in progress at the Northern Great Plains Field Station, but it is as yet too early to draw conclusions. The closer spacing has resulted in better stands and less winter injury in the earlier years, but the trees may become too close and suffer from drought as they get older. There are signs that this condition is already being approached.

If the site for the fruit garden lacks protection from wind and fruit growing is to be attempted without proper shelter, it would probably be advisable to plant so that the trees would have every opportunity to protect one another and to catch snow. Under such conditions it might be best to plant fruit trees in rows 15 to 25 feet apart and to space the trees from 6 to 8 feet apart in the row (fig. 4) or to plant in groups of four trees 2 feet apart (fig. 5), the groups being spaced from 15 to 25 feet apart. The wider distances are suggested for apples and crabs, and the smaller for plums. In each case, bush-form trees should be developed, branching taking place at or very near the surface of the ground. As a further pro-

teetive measure the rows may be run from northeast to southwest, so that the closely planted trees will shade one another from the afternoon sun.

Under adverse conditions when other methods fail, close planting often results in a fair stand. If 25 per cent of the trees fail to grow, the result is not so undesirable as it would be if wide spacing were used, because there is still a fair stand of trees. If a full stand is obtained, all of the trees may be retained until their need for protection has passed, when a sufficient number of the weaker or less desirable trees should be removed before overcrowding begins.

If adequate shelter from wind is provided, it would appear best, in the absence of experimental evidence to the contrary, to plant at standard distances. These distances may be a little closer than rec-

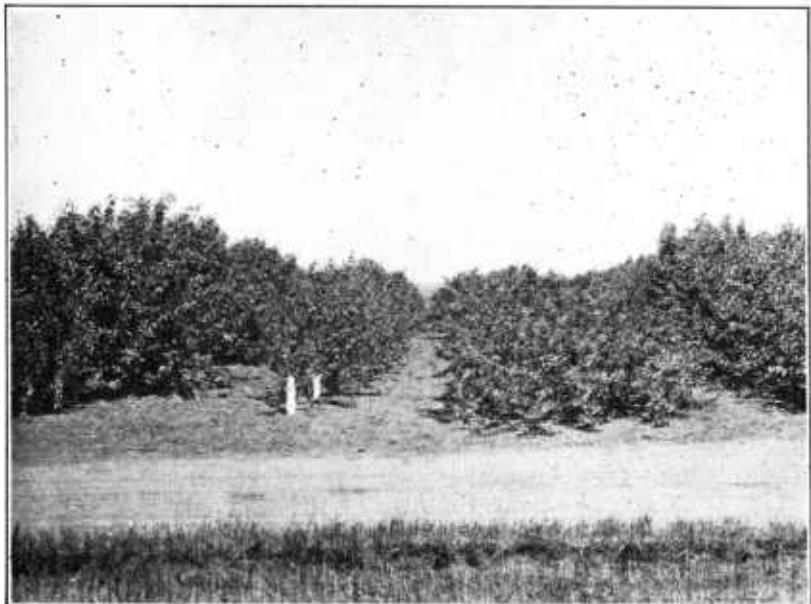


FIG. 4.—"Self-protecting fruit patch" at the Northern Great Plains Field Station. The trees were planted in 1919 in rows 12 feet apart and spaced 4 feet and 6 feet apart in the row. The trees are grown in bush form. Photographed in July, 1923.

ommended for commercial fruit-growing sections, as fruit trees do not often grow very large without irrigation on the northern Plains. On low, rich lands with an underground water supply greater distances than those given may be used to advantage. The following spacing is suggested for ordinary conditions: Apples and crab, 20 to 25 feet; plums, 15 to 18 feet; plum \times sand-cherry hybrids, 12 to 16 feet; sand cherries, June berries, and grapes, about 8 feet each way, or in rows 10 feet apart with the bushes 6 feet apart in the row; currants, gooseberries, and raspberries, rows 6 to 8 feet apart with the plants 4 feet apart in the row; strawberries, rows 3 to 4 feet apart with the plants from 1 to 2 feet apart in the row.

Fruit trees should be planted at least 30 feet from the shelter belt. A distance of 50 or 60 feet would probably be preferable if there is

no snow trap or if the row of shelter-belt trees adjacent to the fruit trees should be such wide-feeding kinds as poplars or cottonwoods. It is often desirable to place a row of wild plums or other wild fruits between the shelter belt and the fruit garden.

CULTIVATION

Referring to the relation of cultural practices to winter injury, J. H. Gourley, of the Ohio Agricultural Experiment Station, has made the following statement: "Practices which maintain a strong vigorous tree and yet permit normal maturity are likely to reduce danger from winter injury."³ On the northern Plains one of the

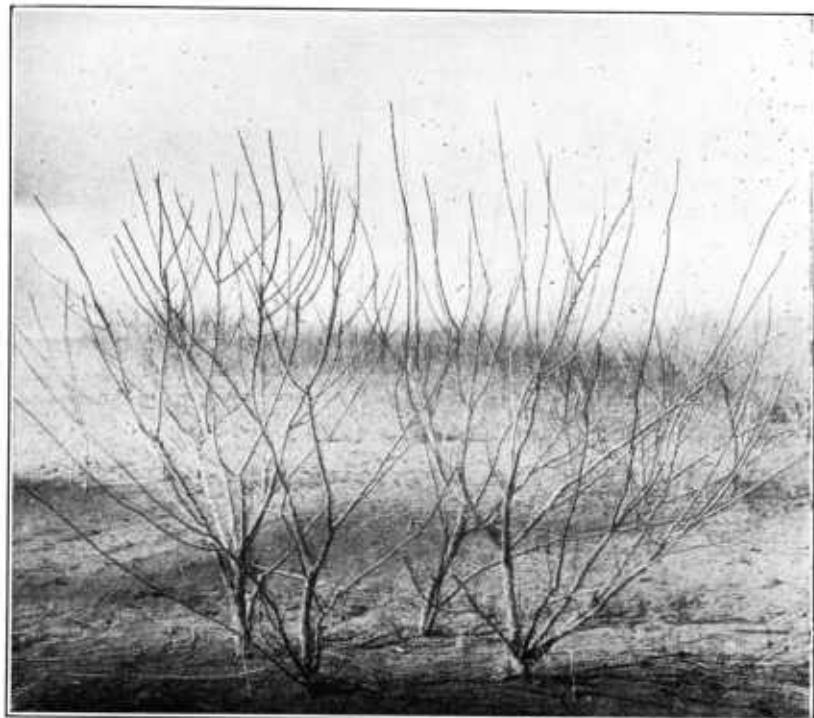


FIG. 5.—Plum trees planted in groups of four in the planting-systems experiment at the Northern Great Plains Field Station

main problems is to keep the trees and other plants in a vigorous, thrifty condition and prevent their being weakened by drought, as plants so weakened often are unable to survive the winter. Consequently, clean cultivation throughout the growing season is recommended. This should be frequent enough to prevent weeds from making any considerable growth. Besides preventing loss of moisture through weeds, clean cultivation prevents the soil from cracking after heavy rains and losing moisture; it may lessen soil blowing by keeping the surface in a rough, granular condition; and puts the surface in a condition to permit the penetration of water from rains.

³ GOURLEY, J. H. TEXT-BOOK OF POMOLOGY. p. 275. New York, 1922.

It is commonly advised to cease cultivation in late July or early August in order to encourage early ripening of the wood and prevent a late sappy growth which might be susceptible to winter injury. It is doubtful if this advice is sound on the Plains, except in unusually wet seasons or in the case of young trees that may be growing too vigorously. As a general rule there is no excess moisture in the soil in late summer or early fall, even when cultivation is continued. If it is not continued, bearing trees may suffer from drought in a dry season and enter the winter in a weakened condition. So it would seem best to start cultivation as soon as weeds begin to grow in the spring, ordinarily in late April, and continue as needed until late in September. A man with a hoe should always follow the culti-



FIG. 6—Orchard cultivator in use at the Northern Great Plains Field Station.

vator and remove weeds close to the trees and plants. Deep cultivation or plowing should not be necessary. The type of orchard cultivator shown in Figure 6 leaves the surface of the ground in a ridged or furrowed condition, which is desirable to check soil blowing and kills weeds effectively if they are not allowed to get too large.

A disk harrow or cultivator may be used to advantage after a cover crop or when there is considerable straw or other rubbish on the land, as it does not clog up as easily as the shovel type of cultivator. The disk is also less liable to catch and break roots. However, it tends to pulverize the soil too finely, thus leaving it in a condition favoring soil blowing, and if the gangs are not reversed in succeeding cultivations the soil often is piled up excessively along the rows and deep furrows are made between them.

When cultivating the orchard care should be taken that neither horses nor implements break or bruise the trees, as such wounds do not heal readily in the dry climate of the Plains. If a tree is damaged, smooth the edges of the wound with a sharp knife and wrap it with burlap or some other material to prevent excessive drying. A coat of white-lead paint or a mixture of coal tar and creosote may be applied to the wound.

If the slope is very steep, loose soil is readily washed away by rains, and cultivation may be impracticable. In such cases a straw or hay mulch may be substituted for clean cultivation. This should be heavy enough to prevent weed growth, and care should be taken that fire does not start in the dry mulch. Each tree must be protected from mice by wrapping with fine woven wire or by other means.

COVER CROPS AND MANURES

In most regions cover crops and green manures have a very important place in maintaining the fertility of orchard soils. Many instances have occurred where continued clean cultivation tended to deplete the humus supply of the soil—which is naturally low in semi-arid regions—and finally resulted in an unproductive orchard. In referring to experiments with cultural practices under irrigation conducted near Victor, Mont., H. Thornber writes: "Continuous clean cultivation proved to be wholly unsatisfactory from the standpoint of either tree growth or fruit production." He advocates plowing under green crops, preferably legumes such as clover, in order to maintain soil fertility and to prevent the exhaustion of organic matter.⁴

Besides tending to keep up the supply of humus in the soil, a cover crop may prevent soil blowing at certain times of the year; and if not plowed under until spring it may aid in catching and holding snow in the orchard during the winter. In fact, there can be little doubt of the value of green manure or cover crops in irrigated districts, but in spite of the benefits derived it is doubtful if they can be recommended for the dry-land fruit grower on the northern Plains. Such crops compete with the trees for moisture and, by causing the trees to suffer from drought, may do far more harm than good. At least their use should be restricted to unusually wet seasons and to vigorously growing young trees. Small fruits are planted so close that cover crops should not be attempted with them.

If a cover crop is sown, experience at the Northern Great Plains Field Station indicates that about the middle of July or a little later is the proper time for seeding. Oats, millet, and peas have been used with fair success. (Fig. 7.) The cover crop should not be planted closer to the trunks of the trees than 6 feet.

Whenever possible, it is desirable to use manure in place of cover crops to keep up the humus supply and fertility of the soil in the dry-land orchard. If a light dressing of stable manure is applied every year, or even one in two years, there should be no ill effects from continued clean cultivation.

⁴ THORNBER, H. ORCHARD CULTURAL PRACTICES. Mont. Agr. Expt. Sta. Bul. 156, 19 pp., illus. 1923.

INTERCROPPING

Any crop grown between the fruit trees competes with them for moisture, and for that reason intercropping can not generally be advised. However, if wide spacing is used (rows 25 feet or more apart), a few rows of some cultivated crop or even one or two rows of small fruits may be grown between the rows of tree fruits for a few years. The danger lies in continuing this practice too long, which would result in the trees being weakened by competition with the intercrop.

IRRIGATION

Although desirable, irrigation is not generally available to the Plains farmers and is not necessary for trees that are otherwise prop-



FIG. 7.—A cover crop of millet in the Hibernal apple orchard at the Northern Great Plains Field Station. Sown in July and photographed in September, 1925

erly cared for. It is especially needed for such small fruits as strawberries and raspberries, which often fail under dry-land conditions because of drought.

If irrigation water is available, it may be used at any time that signs of suffering from drought are shown. Generally, a good irrigation in May or June and another in July to size up the fruit should be sufficient during the growing season. In dry years a third irrigation is desirable in late fall when there is no danger of starting the trees and bushes into active growth. The later this is applied the better, as the object of this irrigation is to prevent drying out and consequent winterkilling during the long winter and the following spring. A straw or hay mulch applied soon after this late fall irrigation will lessen evaporation.

It is better to irrigate thoroughly a few times than to apply frequent light irrigations. The soil should be wet to a depth of at least 4 or 5 feet at each irrigation. Either the furrow or the basin system of applying water may be used. A windmill or a small gasoline engine is often sufficient to furnish irrigation water for the fruit and vegetable gardens. If irrigation is contemplated, comparatively level land should be selected for the fruit planting, so that excessive leveling will not be required.

If there is higher ground above the site, run-off or flood waters may be utilized for irrigation purposes by plowing furrows to divert the run-off water to the fruit garden. It may be desirable to terrace the orchard in order to prevent such water from running quickly



FIG. 8.—Dirt embankments made to catch run-off water and prevent washing of soil in the orchard of John Robertson, near Hot Springs, S. Dak. Photograph in August, 1921.

away or washing the soil. Ridges are sometimes thrown up around or on the lower side of individual trees or groups of trees or bushes to aid in holding run-off water. (Fig. 8.)

PRUNING TREE FRUITS

Pruning is often neglected in the home orchard or so done that the result is worse than no pruning at all. In considering pruning for the Plains area, it is well to remember that large pruning wounds do not readily heal here and that the sunlight is more intense than in more humid regions; consequently the branches should be left a little thicker to shade properly the main limbs and trunk. In other words, pruning should not be so severe on the northern Plains as in

most regions; it is best to practice a light annual thinning out of small limbs rather than any severe heading back or periodic removal of large branches. If a careful annual pruning is practiced from the start, removal of large branches will not be necessary.

Some objects of pruning are:

To influence the form of the tree.

To build a strong framework that will not easily break in the wind or under loads of fruit in later years.

To remove interfering, dead, or broken branches, water sprouts, and root sprouts.

To thin out top branches where they are too thick and produce more shade than is desirable for fruiting spurs and twigs in the center of the tree.

To thin the fruit.

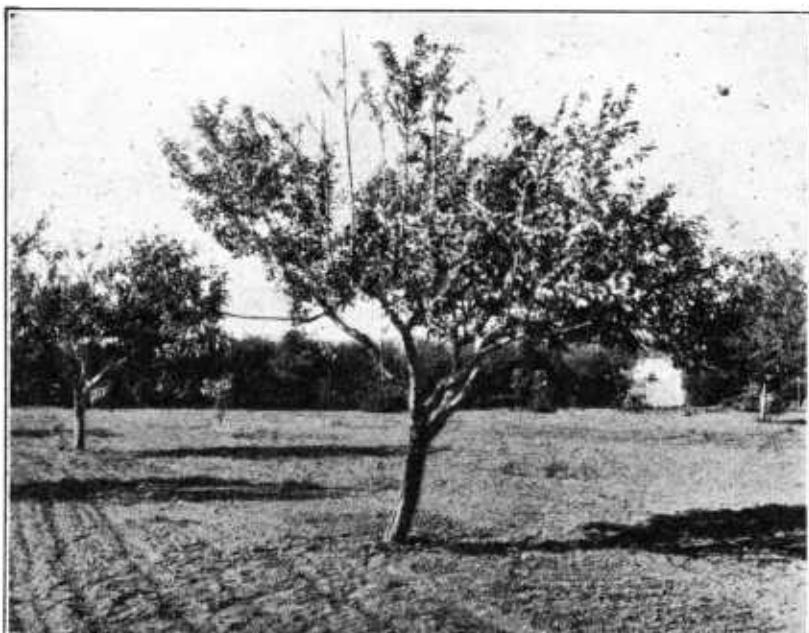


FIG. 9.—An apple tree which has been headed too high. The bark on the southwest side of the trunk has been killed by sun scald

PRUNING THE YOUNG TREE

The purpose of pruning during the first few years is mainly to shape the tree as desired and to develop a strong framework. If well-branched trees are planted, the main or scaffold limbs are selected when the trees are pruned just after planting. If 1-year-old whips are planted the scaffold limbs are selected in the following spring. Suggestions for choosing the scaffold limbs follow.

Not less than three nor more than six main branches should be selected.

Develop a low-headed or bush-form tree. The lowest branch should be less than a foot from the surface of the ground and preferably on the southwest side of the tree. This will of course be impossible with trees that have been trimmed up high in the nursery. An old high-headed apple tree that is suffering from sun scald is shown in Figure 9. The Virginia crab shown in Figure 10 has a much more desirable form. The main branches should start from the trunk at different levels; that is, there should be a space of 4 to 6 inches vertically

between the different branches. If two or more limbs leave the trunk at the same height, they are more liable to split down with a heavy load of fruit in later years. The vertical distribution of the scaffold limbs is shown in Figure 11.

The branches should be so arranged around the trunk that a symmetrical tree is formed: that is, each branch should point out in a different direction. No scaffold branch should be directly above another. The horizontal arrangement of the scaffold limbs is shown in Figure 12.

All scaffold branches should form a wide angle with the trunk of the tree, as sharp-angled branches are liable to split down and seriously damage the tree in later years. Figure 13 illustrates wide-angled and sharp-angled branches.

In removing superfluous branches, cut them off close to the trunk.

These suggestions refer to an ideal tree, which will seldom be found. The pruner should, however, keep such an ideal in mind and develop each tree as near to it as possible, remembering that every tree represents an individual problem.

The pruning after the second season's growth, or after the first season's growth if 2-year-old branched trees are planted, has for its main object the further development of a strong framework. One to three (generally two) well-placed branches are allowed to remain on each scaffold limb, and from a fourth to a half of the annual growth is removed from them. If long and thin, they may be cut back more severely. If two branches that form a sharp angle are allowed to remain, one should be cut back much more severely than the other, which subordinates it to the longer branch. It is doubtful if any further heading back is desirable, except possibly in the case of sand-cherry \times plum hybrids or to suppress any limbs that may be growing too vigorously at the expense of others.

Little pruning is necessary for the next few years, except thinning out to prevent the formation of too many limbs and removing undesirable branches, such as one of two limbs which may interfere or rub each other, or water sprouts, root sprouts, and dead or broken limbs. Figures 14 and 15 show a 3-year-old crab tree before and after pruning.



FIG. 10.—Low-headed Virginia crab tree at the Northern Great Plains Field Station. Photographed in May, 1925. (Compare with fig. 9.)

Young trees often suffer severe winter injury, particularly during the first and second winters after planting. They are frequently killed back to the surface of the ground, and new sprouts spring up which may or may not be the variety desired, depending on whether

the sprouts start from above or below the union of the bud or scion with the root. The origin of such sprouts should be carefully determined and any from the root removed. From one to four sprouts starting above the union of scion and stock should be selected and used to form the framework of a low, bush-type tree. If one is selected, the pruning is essentially the same as on a newly planted tree. If all sprouts appear to be from the stock or root, it is best to pull the plant out and replace it with a new one from the nursery, as root sprouts probably will bear small inferior fruits.

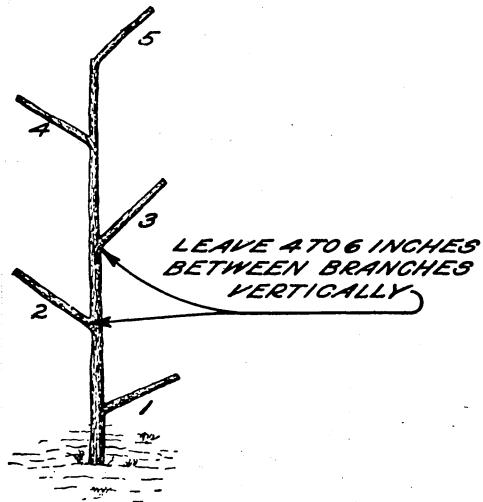


FIG. 11.—Vertical arrangement of scaffold branches. No two should leave the trunk at the same height from the ground

PRUNING THE BEARING TREE

A light but regular annual pruning during the dormant period is recommended for bearing trees. This pruning should take the form of a light thinning out of superfluous branches in the top of the tree, so as to admit light to the main limbs and the center. This encourages the formation of fruit spurs on the larger limbs, and the

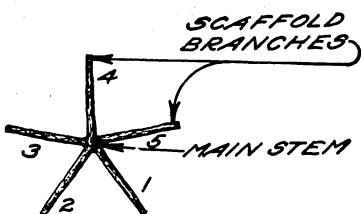


FIG. 12.—Horizontal arrangement of scaffold branches. They should be arranged around the trunk so as to form a symmetrical tree

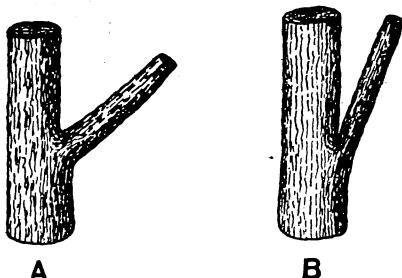


FIG. 13.—Branches of a tree, especially the scaffold limbs, should join the trunk at a wide angle, as shown in A. The sharp angle shown in B is liable to split down when the limbs grow older

trees can hold heavier crops without breaking than they can when most of the fruit is borne near the ends of the branches. Heading back the annual growth is not generally advisable, as it results in stimulating growth near the cut and in a thickening of the growth

near the ends of the branches, and consequently more shading in the interior. Severe pruning at the Northern Great Plains Field Station has in almost every case resulted in decreased yields of plums and plum \times sand-cherry hybrids, without influencing to a marked degree the grade of the fruit. Varieties that tend to overbear, such as Opata and De Soto plums, may be pruned more severely, as this is one method of thinning the fruit. In most cases, however, it is better to thin fruit by hand at an early stage of development than to depend on severe pruning.

Interfering limbs, water sprouts, dead or broken limbs, and root sprouts should of course be removed from the bearing tree, and one of two branches forming sharp angles with each other should be removed or repressed by severe heading back. If the tree has been properly pruned in earlier years, it will seldom be necessary to remove large limbs.

PRUNING WOUNDS

As previously stated, large pruning wounds do not readily heal in the dry atmosphere of the Plains; hence they should be avoided as far as possible. In removing a branch care should be taken to cut it off close to and parallel with a larger limb or the trunk of the tree, as stubs do not readily heal over but remain bad places for rot fungi to gain entrance to the tree and weaken it or finally cause its death (fig. 16).

A dressing is desired that will disinfect the wound and protect it for several years from the entrance of fungi, but which will not injure the bark or interfere with healing processes. M. B. Waite, of the United States Department of Agriculture, has found that coal tar and creosote oil, mixed together so as to form a liquid of the consistency of thick paint, make a dressing for pruning wounds far superior to lead paint, in that it disinfects the wound and makes a more lasting waterproof coating.

Rather thick white-lead paint is perhaps the most common substance used to protect pruning wounds. The chief objections to



FIG. 14.—A 3-year-old Nyslop crab at the Northern Great Plains Field Station before pruning

paint are that it does not disinfect the wound and that it tends to craek and allow the entrance of wood-rot fungi if not renewed from time to time. Piteh, grafting wax, and shellae are other substanees used to proteet pruning or other wounds on trees.

SEASON FOR PRUNING

The early spring, just before growth starts, is ordinarily the best time to prune in the northern Great Plains. However, if there is evidencee of severe winter injury, it is best to wait until after growth starts so that all dead branches may be readily detected and removed.

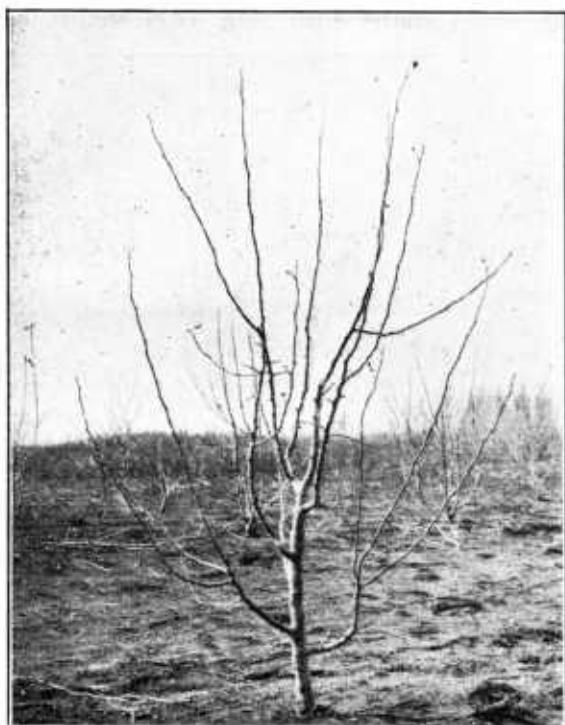


FIG. 15.—Hyslop crab after pruning. This is the same tree that is shown in Figure 14

and in good condition, as all cuts should be close, clean, and smooth.

PRUNING SMALL FRUITS

It is fully as essential to give small fruits a regular annual pruning as it is to prune tree fruits, if a high-grade product is desired.

RASPBERRIES

The hill system of training raspberries is recommended for the northern Plains, where, except under irrigation, drought is the main limiting factor of crop production. Wires are often used to aid in

TOOLS FOR PRUNING

A sharp pruning knife, hand shears, and sometimes long-handled pruning shears for larger branches, are the only tools ordinarily needed for pruning. A pruning saw will also be found useful for removing occasional limbs that are diffielt to cut off close with shears, or for trimming trees that have been negleeted, but the saw should seldom be required on trees properly pruned from the beginning. (Fig. 17.)

The pruning tools should be kept sharp be close, clean, and

holding up the bushes, two wires about $1\frac{1}{2}$ feet apart being stretched about 3 feet high on either side of the row.

As soon as the crop is harvested all old canes should be cut out, as raspberry canes bear fruit only during the second season. Five or six of the best canes of the current season's growth may be left to the hill. These canes will fruit the following year. Some prefer to cut these selected canes back to about 3 feet in height, which encourages side shoots and does away with the necessity for a wire support.

CURRENTS

Little pruning need be given currants for the first few years, except a light thinning out of the weaker shoots and branches. After the bushes become older, pruning is essentially a renewal process, old wood that has borne fruit for several years being removed and vigorous new wood selected to replace the old. Wood over 4 years old should always be removed. No heading back or thinning out of individual branches is generally practiced, but the whole shoot is removed close to the ground after it becomes old and weak.

A good plan is to develop a bush with nine shoots, there being three 3-year-old, three 2-year-old, and three 1-year-old shoots left in the bush after each annual pruning. Each year the three oldest canes are removed and three of the most vigorous new shoots are selected to take their place.

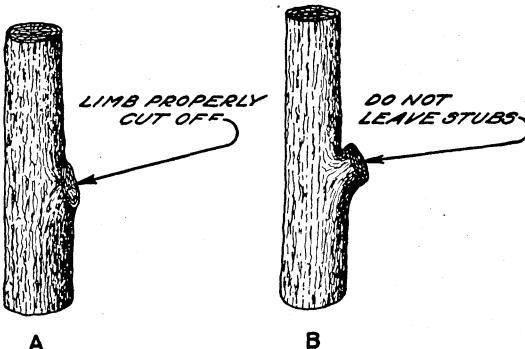


FIG. 16.—In removing a branch from a larger limb or trunk of the tree it should be cut off close, as shown in A. The stub left in B does not heal over readily, and rot fungi, other diseases, or borers may gain entrance to the wound.

GOOSEBERRIES

Pruning gooseberries is essentially a thinning out and renewal process as with currants, weak older wood being removed and vigorous new wood left for future fruiting. Individual branches of the gooseberry are sometimes thinned out if the growth is too thick, but there is not so much cutting out of canes close to the ground as is the case with currants.

Currants and gooseberries may be pruned either in the fall or in the spring, but late spring pruning is recommended, as wood killed during the winter can then be removed. The thick branches serve to protect one another to a certain extent and to hold snow during the winter.

GRAPES

Wires or stakes are used for training grapes. After they are uncovered in the spring the canes may be tied to the wire or stake. Pruning consists in selecting two or three of the most vigorous

new canes, removing others, and severely heading back the canes selected. A large part of the new wood is removed.

NATIVE FRUITS

Little is known concerning the pruning methods best suited for such native fruits as June berries, sand cherries, chokecherries, buffalo berries, and American cranberry bushes. Generally little or no pruning is done, and it is likely that a light thinning out where the growth is too thick is all that is necessary. Severe heading back or pruning of the lower limbs is not recommended. Whenever tried, severe pruning has resulted in decidedly decreased yields at the Northern Great Plains Field Station.

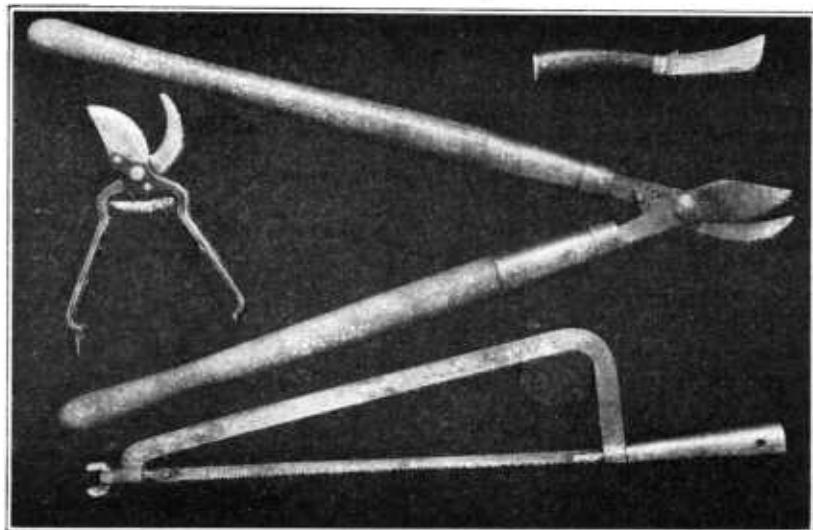


Fig. 17.—Desirable types of pruning tools

THINNING FRUIT

The practice of thinning fruit is generally neglected, or sometimes is done so late in the season that little benefit results. Yet it is very important that fruit trees on the northern Plains be not allowed to overbear if they are to be kept in the vigorous vegetative condition desired. Overbearing results in small fruit of poor grade, large limbs broken by the weight of the crop, the individual fruits not well covered by sprays, and trees so weakened that they may be very susceptible to winter injury.

It is important to thin fruit early in the season, commonly just after the so-called June drop or natural thinning out of fruit that often occurs in early June. Plums should be thinned before the pits harden.

The details of thinning call for some knowledge of varieties, as the fruits of large-fruited varieties should be left farther apart on the limbs than the fruits of small-fruited varieties. Two branches of the same size might be strong enough to hold six Wealthy apples on the one hand or two dozen small crabapples on the other. The fruit on

weak branches that are liable to break should be thinned out more heavily than the fruit on strong branches. In general, apples may be thinned to 5 or 6 inches apart, crabs to 1 or 2 inches, large plums to 2 or 3 inches (figs. 18 and 19), and plum \times sand-cherry hybrids to about 1 inch apart. The thinner should not follow any definite rule for distance, as that will vary with the distribution of the fruit, but he should thin sufficiently to prevent breakage of branches or overbearing, which weakens the tree.

Small fruits are not generally thinned.

SPRAYING

As more fruits are grown in a community, injurious insects and diseases tend to become more prevalent and spraying as a means of



FIG. 18.—Branches of a large-fruited variety of plum tree, before thinning the fruit. Northern Great Plains Field Station, June 17, 1925.

protection becomes more essential. Every farmer who expects to grow good fruit should prepare to spray his trees.

In general, there are two classes of insects: (1) Those with biting mouth parts, including caterpillars, beetles, grasshoppers, and various other insects which chew or eat the leaf; and (2) those with sucking mouth parts, of which plant lice or aphids are the most common example. Some form of arsenic, such as arsenate of lead, is commonly used to poison insects with biting mouth parts, and nicotine sprays are effective in controlling soft-bodied sucking insects. Bordeaux mixture and lime-sulphur sprays are used as fungicides to control fungous diseases such as scab, certain cankers, brown rot, plum pocket, and fungous blights and wilts. Pear blight or fire blight, a bacterial disease working inside the bark, can not be controlled by spraying. Blighted limbs or cankers may be cut out

considerably below the visible evidence of the disease and the cut branches burned. Tools should be disinfected after each cut.

The following spray formula is the one commonly used for apples and plums at the Northern Great Plains Field Station:

Arsenate of lead (powder)-----	$\frac{1}{2}$ pound.
Lime-sulphur concentrate-----	$2\frac{1}{3}$ quarts.
Water-----	20 gallons.

If plant lice or other soft-bodied sucking insects are present, 3 fluid ounces of nicotine sulphate (40 per cent) may be added to the foregoing formula, or the nicotine and water with about 1 pound of soap may be used as needed.

For bearing apples and crabs, the first spray is applied just before the blossoms open, the second just after the petals fall, and the third



Fig. 19.—The same branches shown in Figure 18 after thinning the fruit

in late June or early July. This is ordinarily all that is required, although a fourth spray is sometimes advised for the latter part of July.

Bearing plums are sprayed just before the blossoms open, again when the plums are about the size of small peas, and in late June or early July. As with apples, a fourth spray is sometimes recommended later in the season. As plums and apples require about the same schedules, it is generally practicable to spray them at the same time.

Small fruits may be sprayed whenever currant worms, caterpillars, or aphids are noticed on the bushes.

Young trees and bushes may not need spraying, but the farmer should be prepared to spray if insects start damaging the foliage.

A common horizontal type of barrel-pump sprayer, equipped with an agitator and 20 to 25 feet of hose, has been found convenient for the home fruit garden (fig. 20).

A fairly high pressure, at least 100 pounds, is desirable. Care should be taken to cover thoroughly all parts of the plant with the spray.

PROTECTION FROM RABBITS AND MICE

It is likely that rabbits and mice, particularly the former, have killed a very large percentage of the apple and crab trees that have failed to survive on the northern Plains. Protection from these pests is even more important than spraying, at least for young trees.

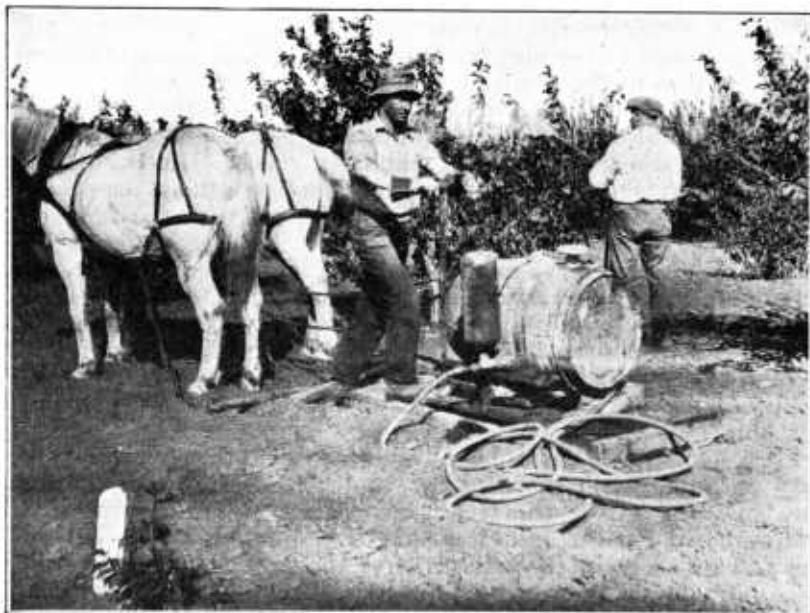


Fig. 20.—Spraying a young orchard with a barrel-pump sprayer. Northern Great Plains Field Station, July, 1925

If possible, the farm fruit garden should be inclosed with a rabbit-proof fence. If this is not practicable, it is advisable to wrap the trunk and larger branches of each tree with wood-veneer wrappers, heavy paper, burlap, cornstalks, or fine woven wire. This should be done before the first heavy snows of early winter, and the wrappers should remain on the trees until grass and vegetation start to grow in the spring.

If the snow is not drifting, it sometimes pays to shovel it away from the trunks of the trees, so that the rabbits can not reach the higher, unprotected branches.

Poisoning also serves to keep rabbits in check. Poisoned corn, oats, and alfalfa have been used at the Northern Great Plains Field Station with fair success. Directions for preparing poisoned

oats, as furnished by the Bureau of Biological Survey, United States Department of Agriculture, are as follows:

Mix 1 tablespoonful of starch in one-half cupful of cold water and stir into 1 pint of boiling water to make a thin clear paste. Mix 1 ounce of powdered strychnine with 1 ounce of powdered bicarbonate of soda (baking soda) and stir with the starch to a smooth creamy mass. Stir in 1 teacupful of table salt, apply to 12 quarts of good clean oats, and mix thoroughly to coat each kernel.

The above directions will serve for 12 quarts of corn instead of oats. The grain is distributed in small piles where rabbits feed.

Poisoned alfalfa leaves may also be used, directions by the Bureau of Biological Survey being as follows:

Dissolve 1 ounce of strychnine sulphate in 2 gallons of hot water and sprinkle over 10 pounds of alfalfa hay leaves. Mix the leaves thoroughly until all moisture is absorbed.

The poisoned leaves may be distributed in small handfuls in rabbit paths leading to the orchard and in the orchard itself.

In handling poisons, care should be taken that they are kept out of reach of children and that livestock are not poisoned.

Shooting also tends to keep rabbits in check. Blood smeared on the trees or fresh raw liver rubbed on them seem to act as a repellent to the rabbits. Such treatment should be given in the fall and repeated once or twice during the winter. Paints and washes of various kinds also serve as repellents. Lime-sulphur applied at the rate of about 1 gallon of concentrated lime-sulphur to 10 gallons of water has been used with some success. The addition of about 1 pound of glue to each gallon of lime-sulphur adds somewhat to its durability. Such repellents may be more or less effective, the difficulty being that they often wear off in a few weeks and leave the tree unprotected.

Mice sometimes build nests in straw or other material which may be put around the tree for winter protection and may gnaw the bark and girdle the tree. Experience at the Northern Great Plains Field Station indicates that if the mulch is applied late in the fall or early in the winter after the ground is frozen and the mice have found their winter quarters there is not likely to be any trouble. If mice are present the trees must be protected by wood-veneer wrappers or fine wire, or the mulch must be removed from close to the trunks. Mounds of dirt, 8 to 10 inches high, may be piled around the tree trunks and will serve to protect the trees. Poisoning may be resorted to.

Severe pruning may be necessary for trees that have been damaged by rabbits or mice. Girdled limbs should be removed, and sometimes, if the trunk has been girdled, it is necessary to cut off the entire top of the tree. In that event sprouts come from near the ground and are trained to form a new top. If the bark is eaten on only one side of a limb, the rough edges may be cut away and the damaged part wrapped with some material to reduce drying out, or the wound may be painted with white-lead paint or other substance. Sometimes bridge grafting is resorted to when the trunks of valuable trees have been girdled.

Trees injured by hail are also pruned back severely and the damaged parts wrapped or painted to prevent excessive drying.

SPECIAL WINTER PROTECTION

Some fruits require special winter protection on the northern Plains, and protection may also be desirable for some other fruits during the first few winters after planting.

Strawberries should be covered with about 6 inches of clean straw just after the ground freezes. The straw may be removed in early spring if clean cultivation is practiced, or it may be left as a mulch between the rows until after harvest. The latter method produces cleaner fruit and is effective if weeds do not become troublesome.

Raspberries and grapes, except the hardy native grape, should be completely covered with soil during the winter. They are covered just before the ground freezes in the fall, generally in late October, and are uncovered just before the buds start growth in the spring, generally about the 1st of May. Care must be taken not to break the canes when they are bent over for covering. Cutting the roots on one side of the plant with a spade facilitates bending without breaking. The canes are bent over and the tops held down with a shovelful of soil. The canes are then completely covered either by shoveling soil on them or by plowing a furrow on them from each side of the row.

The most difficult period with fruit trees is the first two years after planting. It often pays to give them special winter protection during this comparatively tender period. If the trunk and main branches are properly wrapped to prevent rabbit injury, such wrapping will also serve to lessen drying out and sun scald of the bark. A goodly number of cornstalks tied around each tree in late fall, with the tops sticking up through the branches, will help to protect the trees from both rabbits and wind.

The roots of young trees are often protected by piling soil, old manure, or partly rotted hay or straw around the trunks of the trees during the winter or by covering the entire fruit garden with 8 to 10 inches of straw or old hay. In either case the mulch is applied in late fall and removed before the trees start growth in early spring. The mulch aids in protecting the roots from winter injury, but has no effect in delaying the time of bloom in the spring, as many persons think it does. As before stated, care must be taken that mice do not build nests in the mulch and damage the trees.

Sometimes in late fall a board is driven into the ground near each tree to shade the southwest side of the trunk in the afternoons of winter and early spring and thus prevent sun scald. Whitewashing the trunk and larger limbs also lessens the danger from sun scald, as the white surface remains cooler in the sunshine than would the darker bark. The whitewash is applied in early December and again in early March, warm days being chosen so that the whitewash will dry before freezing.

It is possible even to lay fruit trees down and entirely cover them with dirt, but this involves considerable work if done carefully. If it is to be done, trees should be planted in a slanting position to facilitate laying down without breaking. It is doubtful if this method will ever become common.

KINDS AND VARIETIES OF FRUITS

Fruit growing on the northern Great Plains is restricted to the most hardy kinds and varieties. Such fruits as pears, peaches, apricots, quinces, cherries, grapes, blackberries, dewberries, and nuts are not generally hardy in this section, and their planting can not be advised. Apples, crabs, plums, plum \times sand-cherry hybrids, sand cherries, June berries, currants, gooseberries, raspberries, and strawberries can be grown with a greater or less degree of success, depending on the district, the varieties chosen, the moisture supply, protection from wind, and the care given. Seedlings of hardy native fruits including plums, June berries, western sand cherries, golden currants, buffalo berries, chokecherries, and American cranberry bushes may be grown to advantage on the dry-land farm. Some of the native fruits, such as plums, buffalo berries, and chokecherries, may be used as outside or inside rows of the shelter-belt planting and there serve the dual purpose of providing shelter and producing some fruit.

Plant breeders have made a great deal of progress in introducing new, improved varieties of fruits, especially plums, adapted to conditions on the Plains. As a result, the present list of recommended varieties is decidedly superior to a corresponding list of even 10 years ago, and much further improvement may be expected in the future.

A long period of trial under many different conditions is required to determine definitely the merits of a new variety. It is best for the grower to plant most of his ground to those standard varieties that have proved their merits under varying conditions for a number of years. Some room may then be given to the newer sorts which appear to be promising but lack extensive tests.

It is well to select varieties that will supply fresh fruit for the table over a comparatively long period of time in the summer and fall. By judicious selection fresh fruit can be picked almost continuously from the time strawberries begin to ripen in late June until the last apples are harvested in late October, or for a period of about 4 months of the year.

It is best to plant two or more varieties of each kind of fruit, as many varieties are self-sterile. In other words, pollen from some other variety of the same kind of fruit is required if the flowers are to be effectively fertilized and fruit is to set. This explains why trees of a single variety so often bloom profusely but fail to set fruit. The two varieties must bloom at about the same time, so that bees and other insects may carry pollen back and forth from one variety to the other.

It is obviously impossible to give a list of fruits best suited to all parts of the northern Plains, as it is possible to grow some fruits at low elevations in the eastern part that would not mature at the higher altitudes nearer the Rocky Mountains or, perhaps, in the extreme northern part of the section. It is desirable for the farmer to write to his State agricultural college and to seek the advice of any neighbors who have succeeded in growing fruit, in order to determine which varieties are the safest for him to plant. The recommendations that follow are based on variety trials conducted at the Northern Great Plains Field Station and on observations made on the northern Plains.

APPLES AND CRABS

Apple production is uncertain on the northern Plains and should be attempted only in well-protected places. But few varieties are hardy enough to survive the winters, the season is too short for the fruit of many varieties to ripen, the fruit is often blown from the trees before reaching maturity, and rabbits seem to prefer the bark of apple trees to that of most others. If apples are to be included in the home fruit garden they should be given every possible protection and care. Many persons have succeeded in growing good apples in towns, where the trees were protected by buildings and where they could be watered, but there are fewer instances of success on farms.

Many apple and crab trees have failed to survive, because of tender roots. The common French crab stock is not hardy enough for the northern Plains. Siberian crab (*Malus baccata*) seedlings have been most satisfactory as stocks for apples and crabs at the Northern Great Plains Field Station. Seedlings of such hardy crabs as Virginia or Transcendent may also be used for stocks, or hardy apple and crab varieties may be grown on their own roots.

STANDARD VARIETIES OF APPLES

The hardiest varieties of apples for the northern Plains are mostly of Russian origin. Brief comments on some standard varieties which appear to be best suited to the section are given below. The varieties are arranged in order of ripening from the earliest to the latest. The references to the time of ripening apply only to observations made at the Northern Great Plains Field Station, Mandan, N. Dak.

Yellow Transparent.—This is a Russian apple and is of value because of its earliness. The fruit usually ripens about the middle of August, is medium to large in size, pale yellow, fair for either dessert or culinary uses, but not a good keeper. The trees are not thought to be as hardy or thrifty as some other Russian varieties and are somewhat subject to blight.

Oldenburg.—This apple, commonly known in the Northwest as the Duchess, is one of the most widely planted of the Russian varieties. The fruit usually ripens in the latter part of August, is medium to large in size, striped with red, pleasantly subacid, fair for dessert and good for culinary uses, but is not a good keeper. The tree comes into bearing at an early age, is hardy and productive for an apple, but is not considered very long lived. Oldenburg should be included in the home fruit garden wherever apples are grown on the northern Plains.

Okabena.—Okabena is a seedling of Oldenburg which has not been thoroughly tested at the Northern Great Plains Field Station, but because of its reported hardiness and success in some parts of the Plains it is thought to be worthy of mention. The fruit ripens in the early part of September, is medium in size, striped and splashed with light red, subacid, and fair for culinary use. The tree is productive and hardy for an apple, but is not considered as good as its parent.

Wealthy.—This seedling of Cherry crab originated in Minnesota and is one of the best dessert apples that can be grown on the northern Plains, although it is not so hardy as some of the Russian varieties. The fruit generally ripens from the first to the middle of September, is medium to large in size, striped and splashed with red, juicy, agreeably subacid, and good for either dessert or culinary use. It keeps better than Oldenburg. The tree is not so hardy as could be wished, but it fruits at a fairly early age and is generally productive.

Patten.—Patten, a seedling of Oldenburg, originated in Iowa and resembles its parent in some fruit and tree characteristics. The fruit generally ripens in the middle of September, is medium to large in size, green in color, subacid,

fair for dessert, and good for culinary uses. This variety is one of the hardiest of the apples, and the trees are generally productive.

Hibernal.—This Russian variety is perhaps the hardiest 'apple of them all. The fruit generally ripens about the middle of September, is large, striped with red (often only on one side), subacid, astringent, too sour for dessert, but fair for culinary uses. The tree will grow if apples will grow at all, is generally productive, and makes an unusually strong framework suitable for top-working other varieties.

Other varieties.—Some newer varieties which appear promising are Anoka, Red Wing, Folwell, Haralson, and Erickson. Anoka fruits at a very early age, appears to be hardy, and is comparable to Oldenburg in most qualities.

STANDARD VARIETIES OF CRABS

Crabs have been more satisfactory than apples, as they are hardier as a class, often bear at an earlier age, and the fruit is not so easily blown off the tree. Some of the best standard varieties, arranged in the order of ripening, are the following:

Florence.—This crab generally ripens in the latter part of August or in early September. The fruit is medium to large in size, flat in shape, striped and splashed with bright red, very attractive, subacid, somewhat astringent but good for culinary uses. The tree is not so hardy as Transcendent or Virginia, but the blossoms seem to be able to withstand spring frosts better than those of most varieties, hence it is very prolific and deserves a place in the home fruit garden in favorable districts or where the site is very well protected.

Whitney.—Whitney ripens about the same time as Florence. The fruit is large for a crab, light yellow shaded and striped with red, mildly subacid, and good for either dessert or culinary uses. The tree is probably a little hardier than Florence but has not been so prolific at the Northern Great Plains Field Station. It is suited for growing in the same districts as Florence.

Transcendent.—Transcendent generally ripens before the middle of September. The fruit is medium to large for a crab, attractive yellow and red when ripe, round in form, subacid, somewhat astringent but good for culinary uses. The tree is unusually thrifty, hardy, and productive on the northern Plains. The worst fault of Transcendent is its susceptibility to blight, and for this reason its planting can not be recommended in districts where blight is known to be troublesome.

Lyman.—This crab is also known as Lyman Prolific. It is about the size and quality of Transcendent, but a little later in ripening. This variety is one of the hardier crabs and is fairly prolific.

Red Siberian.—Red Siberian is one of the hardiest of the named varieties of crabs. It ripens about the middle of September, does not blow off the tree easily, generally is prolific, and has a place in districts where better crabs can not be grown. The fruit is small, pale yellow striped and blushed with red, subacid, astringent but acceptable for culinary uses. Except for color, the remarks about Red Siberian also apply to Yellow Siberian.

Hyslop.—Hyslop usually ripens from the middle to the latter part of September. The fruits are medium to large, deep attractive red, subacid, astringent but good for culinary uses. The trees are fairly hardy for crabs, but like Transcendent are subject to blight. This variety is not considered so good as several others.

Virginia.—This variety ripens a little late for the northern Plains, but it has so many desirable characters that it is strongly recommended for the home fruit garden, except in districts having unusually short growing seasons. Virginia ripens in the latter part of September at the Northern Great Plains Field Station. The fruit is large, blushed and striped with red, attractive, pleasantly subacid, juicy, fair for dessert, and good for culinary uses. The tree is hardier than most varieties, a thrifty grower, and the limbs are strongly attached to the tree.

Other varieties.—Among less well-known varieties of crabs that deserve mention are Silvia, Dolga, and Robin, given in their order of ripening. The first is a yellow crab, of good size, ripening about the middle of August. Dolga is a bright red crab, small to medium in size, which ripens in early September. Robin is a yellow and red crab of medium size, also ripening in early September. They have been among the hardiest crabs tested at the Northern Great Plains

Field Station, bear at an early age, and are good for culinary uses. They are particularly recommended for trial in districts where the earlier, hardier crabs are needed.

PLUMS AND PLUM HYBRIDS

Plums and plum hybrids are by far the most reliable tree fruits for the northern Plains and should form a considerable part of the home fruit garden. Varieties may be selected which will extend the harvest season from the time Opata ripens—generally before the middle of August at Mandan, N. Dak.—until Emerald is picked, which is generally after the middle of September. The season is more restricted in districts having a shorter frost-free period.

Hardy native plum seedlings are thought to make the best stocks for plums in this section. Sand cherry (*Prunus pumila* and *P. besseyi*) seedlings also have been used successfully as a hardy stock for plums, but the sand-cherry root suckers badly, the tree is liable to become topheavy and blow over, and there is some evidence that this root may result in a shorter lived tree. On the other hand, there is no difficulty in determining whether shoots are from the root or the scion, as the foliage of the sand cherry is very different from that of the plum. The sand-cherry root does well in sandy soils.

Plums recommended for the northern Plains section may be divided into three general groups, namely, native plums (mostly *Prunus americana* or *P. nigra* selections), hybrids between native and Japanese (*P. salicina*) plums, and hybrids between either native or Japanese plums and the native sand cherry (*P. besseyi*).

NATIVE PLUMS

Native plum varieties have long been considered the most reliable tree fruits for the plains and prairies of both the United States and Canada. As a group they possess unusual hardiness and drought resistance for fruit trees, they are prolific bearers, and the fruit is acceptable for dessert and culinary uses. They are not, however, first-class for either purpose, as they are characterized by a tough, sour skin and considerable sourness near the pit, especially when cooked. A few native plums should be included in every home orchard because of their hardiness and fruitfulness, and also because they generally furnish an abundance of pollen for cross-pollination purposes, whereas the hybrids are often deficient in pollen production.

Standard varieties of native plums that have been grown successfully at the Northern Great Plains Field Station are listed below in their order of ripening. As with apples and crabs, the time of ripening given is for Mandan and vicinity and will vary to some extent in different parts of the northern Plains. Also, the time of ripening given represents an average time. The ripening date of a variety often varies as much as two weeks before or two weeks after the time given.

Cheney.—Cheney generally ripens in early September. The fruit is medium size, red, juicy, and of fair quality. The tree is fairly hardy but has not been a heavy yielder at the Northern Great Plains Field Station. It blooms early, thus being subject to damage from late spring frosts. Cheney is reported to be among the best varieties on the Canadian prairies and did well in tests in Wyoming; it may therefore have a place in parts of the northern Plains, but the results of tests at Mandan are not so favorable as with some other varieties.

Wolf.—Wolf also ripens in early September (the ripening date ranged from August 26 to September 24 in the four years from 1921 to 1924, inclusive). The fruit is small to medium in size, dull red, freestone, and of good quality for a native plum. The tree is generally hardy, fairly productive, and is one of the best of the old standard varieties.

Terry.—Terry generally ripens before the middle of September. It is one of the largest of the American plums, an attractive red and yellow when ripe, firm fleshed, clingstone, and of good quality for its group. Young Terry trees have not been so hardy as other Americana varieties at the Northern Great Plains Field Station, but of late years bearing trees have been both hardy and prolific. The variety seems to be very subject to aphid attack. However, because of the size and quality of the fruit and its regular bearing habits, Terry is considered one of the best of the Americana plums.

Surprise.—Surprise usually ripens about the middle of September. This is a medium-sized to large plum, attractive bright red, clingstone, and of good quality. The tree is fairly hardy and a thrifty grower, but except for one year the variety has been a scanty bearer at the Northern Great Plains Field Station. It is also a shy pollen producer for a native plum.

Wyant.—Wyant also ripens about the middle of September. The fruit is small to medium in size, yellow blotched with red, nearly freestone, and of fair quality. The tree is one of the hardiest of its class, is a prolific annual bearer, and produces an abundance of pollen for cross-pollination purposes. The fruit is not so good as that of some other varieties, but the hardiness of the tree and its heavy bearing habits recommend it for a place in the home fruit garden, probably above varieties of better quality, like Surprise, which tend to be unfruitful.

De Soto.—De Soto usually ripens about the middle of September. The fruit is small, yellow with red cheek, clingstone, and of good quality for an Americana plum. The trees tend to overbear and have not been so hardy or thrifty as Wyant and Wolf at the Northern Great Plains Field Station.

Forest Garden.—This variety ripens about the same time as Wyant, or a little later. The fruit is small to medium in size, red, clingstone, and of fair quality. The tree is fairly hardy and a heavy annual bearer. However, it produces little pollen and is not considered so valuable as Wyant or Terry for the home fruit garden.

Some promising newer varieties of native plums are listed below.

Assinniboine.—This is a variety of *Prunus nigra* that appears to be better than Cheney, as it is earlier, larger, and of better quality. It is probably worthy of trial but has not been tested long enough at Mandan to draw conclusions.

Mammoth.—This variety has done very well in Canada and appears to be worthy of trial.

“**Mandan Selection 75.**”—This selection usually ripens in the latter part of August. It resembles De Soto, but the fruit is larger, clingstone, sweet, and of fair to good quality. The tree appears to be very hardy. Because of its earliness this selection is thought to be of value in districts where such varieties as Wolf or Terry do not ripen before frost.

“**Mandan Selection 73.**”—This plum, also called “Training School Special,” was found growing in an orchard near the Northern Great Plains Field Station. It is believed to be from the seedling root, as it has not been identified as any named variety. It ripens early in September. The fruit is large, attractive red, clingstone, sweet, and of good quality. The tree appears to be hardy and a reliable annual bearer. It is earlier than most Americana varieties, and because of its size and quality is thought to be worthy of trial.

Teton.—Teton is a selection made in South Dakota by N. E. Hansen. It ripens about the middle of September or a little earlier, is of medium to large size, red, sweet, clingstone, and of good dessert quality for a native plum. The trees have been among the hardest plums tested at the Northern Great Plains Field Station, are thrifty growers, prolific yielders, and abundant pollen producers. The fruit drops badly when ripe, but the good qualities of this variety would seem to give it a place in the home fruit garden.

JAPANESE HYBRID PLUMS

Of late years a new class of plums has made its appearance in the Northwest which by reason of large size, comparatively small

pits, and superior dessert quality threatens largely to replace the old standard Americana and nigra varieties. As a class, the native \times Japanese hybrid plums are not so hardy as native varieties nor so prolific, nor do they produce more pollen. For these reasons it would seem best not to discard the native varieties, but to grow some of each class in the home garden.

Some of the better known hybrid plums are listed below in their order of ripening.

Hanska.—Hanska usually ripens from the first to the middle of September. The fruit is medium to large in size, very attractive dark red, firm of flesh, clingstone, and delightfully flavored like its apricot-plum parent. However, the tree lacks hardiness and vigor and has not been productive at the Northern Great Plains Field Station, although it has been one of the best plums tested at the State Agricultural College at Bozeman, Mont. It may have a place in unusually well protected sites, but it can not be generally recommended.

Waneta.—Waneta also ripens from the first to the middle of September. The fruit is very large, attractive red, clingstone, and of good dessert quality. Trees of this variety suffered severely from winter injury in the earlier years at the Northern Great Plains Field Station, but both bearing and young trees have apparently been hardy of late years. This variety is a thrifty grower and deserves a place in the home garden, especially if the site is well protected.

Emerald.—Emerald ripens about the middle of September or a little later. It is probably too late for much of the northern Plains. The fruit is large, mottled red and yellow, clingstone, very juicy, soft fleshed, and very good for dessert uses. Trees of bearing age have been hardy at the Northern Great Plains Field Station, are thrifty growers, and are among the most prolific of the Japanese hybrid varieties. This plum is deemed worthy of planting in districts of the northern Plains having comparatively long growing seasons.

A number of newer or less known varieties of Americana \times Japanese hybrid plums appear to be very promising for the northern Plains, but further trials are necessary to determine their hardiness and productiveness. Some of the most promising are mentioned below.

Oziya.—Oziya usually ripens in the latter part of August and is, with the exception of Opata, the earliest plum at the Northern Great Plains Field Station. The fruit is large, attractive mottled red on yellow background, clingstone, juicy, sweet, and of good dessert quality. The tree may lack hardiness except in the more favorable districts of the northern Plains. The fruit ripens unevenly (not a serious objection in the home garden) and drops badly when ripe. Oziya is generally a heavy bearer, and because of its large size and good quality is deserving a trial, but only in well-protected orchards.

Cree.—Cree ripens shortly after Oziya. The fruit is medium sized to large, red, clingstone, sweet, and of good quality. The tree has been hardy and a reliable bearer at Mandan. This variety deserves trial, particularly in districts having a comparatively short growing season.

Ojibwa.—Ojibwa usually ripens in early September. The fruit is medium sized to large, attractive bright red, clingstone, firm fleshed, and of fair to good quality. The tree has been hardy and a reliable bearer at the Northern Great Plains Field Station. This variety is thought to be worthy of trial in districts where better hybrid plums lack hardiness or do not mature.

Red Wing.—Red Wing generally ripens in the first part of September. The fruit is very large, attractive mottled light red on yellow background, free-stone but with a rather large pit, and of good dessert quality, although some find the flesh a little dry. Bearing trees have been hardy at Mandan, although young trees suffered from winter injury. It seems to be a reliable bearer and to deserve trial in well-protected sites on the northern Plains. It is regarded as perhaps the most promising Japanese \times Americana hybrid plum tested at Mandan.

Mendota.—Mendota ripens shortly after Red Wing. The fruit is large, attractive deep red, with a small pit but clingstone, juicy, sweet, and for dessert quality perhaps the best plum tested at the Northern Great Plains Field Station. Bearing trees have been fairly hardy, but young trees killed back

badly. The variety has been a shy bearer and is susceptible to aphid attack. However, because of its fine quality, it is deemed worthy of trial in unusually well-protected sites or in the more favorable districts of the northern Plains.

Tonka.—Tonka ripens in early September at about the same time as Mendota. The fruit is large, attractive red, freestone, small pitted, and of very good dessert quality. The objections to Mendota also apply to Tonka, and it is recommended for trial under the same conditions.

Stella.—Stella ripens shortly after Tonka. The fruit is large, dark red, with a rather large pit, clingstone, firm fleshed, and of fair to good quality, but not considered so good for dessert as several others of its group. Bearing trees have been hardy at the Northern Great Plains Field Station but have not been very reliable bearers.

Omaha.—Omaha resembles Emerald to a marked degree and ripens at the same time. It is thought that the remarks concerning Emerald will also apply to Omaha. Some have found it superior to Emerald.

Waconia.—Waconia ripens about the same time as Emerald, and therefore is also late for much of the northern Plains. The fruit is large, attractive bright red, clingstone, firm of flesh, and of fair dessert quality. The tree is one of the hardiest of the Americana \times Japanese hybrids tested at the Northern Great Plains Field Station, and it appears to be a reliable bearer. Because of these desirable qualities it is worthy of trial.

Underwood and La Crescent.—These are two of the newer varieties originated by the Minnesota State Fruit-Breeding Farm which, because of their success in preliminary trials in other districts, are thought to be worthy of trial on the northern Plains. La Crescent is a large yellow plum of good quality. Young trees of these varieties have not been entirely hardy at the Northern Great Plains Field Station, but they have not yet reached a bearing age.

SAND-CHERRY HYBRIDS

The plum \times sand-cherry hybrids are a class of plums of great value for the northern Great Plains section. The trees tend to bear at an early age, are generally prolific, hold the fruit firmly so that it is not easily blown off, and bloom late, thus tending to escape late spring frosts. They generally ripen their fruit early in the season, are drought resistant, and suffer very little from attacks of aphids. These hybrids are generally superior to native plums for culinary uses, as they have a tenderer skin, a smaller pit, and considerably less of the objectionable sourness of native plums when cooked. Some varieties come nearer to taking the place of the cherry than anything else at present in the nursery trade.

Objections to the plum \times sand-cherry hybrid group are that the trees tend to be short lived and generally produce but little pollen, while the fruit is often of small size and as a rule keeps poorly. Trees in this group should be grown in bush form only. (Fig. 21.)

Standard varieties of plum \times sand-cherry hybrids are listed below in their order of ripening.

Opata.—Opata is the earliest plum of all, generally ripening before the middle of August at Mandan. The fruit is small to medium in size, has deep blue skin, green flesh and small pit, is clingstone, of only fair dessert quality, but good for culinary purposes. The tree is drought resistant, fairly hardy, and very prolific, often tending to overbear. Average yields from Opata have been higher than those from any other variety tested at the Northern Great Plains Field Station. It is recommended for every home fruit garden.

Sapa.—This variety ripens in the latter part of August, generally about 9 or 10 days after Opata. It is of about the same size and skin color as Opata, but has a dark red or black flesh, and is of very good quality, especially valuable for culinary uses, where it takes the place of the cherry in pies and sauce. The tree is not so hardy as Opata nor so reliable a bearer, but because of the superior quality of the fruit it is recommended for the more favorable districts and well-protected sites. (Fig. 22.)

Compass.—Compass usually ripens in late August. The fruit is small, red and yellow, clingstone, of only fair dessert quality, but good for culinary uses. Compass will probably stand up and bear fruit under as severe conditions as any variety. The tree is very hardy, drought resistant, and a heavy annual bearer. A few trees of this variety should always be included in the home fruit garden. (Fig. 23.)

Certain other plum \times sand-cherry hybrids less well known than those considered above are here described, since preliminary tests indicate that they are worthy of trial.

Tom Thumb.—Tom Thumb resembles Sapa in that it ripens at about the same time and has the same dark red or black flesh. The quality for culinary uses is if anything a little better than that of Sapa, although the fruit averages a little smaller in size. This is a distinctly dwarf variety, and the trees may be planted almost as close as sand cherries or grapes. It appears to be very productive and is recommended for trial, although its hardiness is questionable.

Zumbra.—This variety may not strictly belong in the plum \times sand-cherry group, as it is thought to contain some sweet-cherry and perhaps some pin-cherry blood, as well as that of plum and sand cherry. It generally ripens



FIG. 21.—Part of the plum variety-testing orchard at the Northern Great Plains Field Station, showing plum \times sand-cherry hybrids and their characteristic bush form. Photographed in August, 1919.

about September 1 and resembles Opata or Sapa in size and outward appearance. The flesh is green, and when fully ripe the quality is good for both dessert and culinary uses, especially the latter. Zumbra has not been tested long enough at the Northern Great Plains Field Station to draw conclusions as to its hardiness, but the young bushes appear to be hardier than Sapa and probably as prolific. It has not been so hardy as Compass or Opata but is worthy of trial in the home fruit garden.

"Mandan Selection 69."—This selection made at the Northern Great Plains Field Station is a seedling of Sioux sand cherry, having some unknown plum for the male parent. It is thought to be an improvement on Compass in that it is earlier, larger, and sweeter, but it has not been tested long enough for definite recommendations to be made.

CHERRIES

None of the common varieties of cherries in the nursery trade are hardy enough for general planting on the northern Plains. Success is occasionally obtained in unusually well-protected sites in the most favorable districts with such varieties as Early Richmond, Dye-

house, or Wragg, but cherries can not be generally recommended for this section.

Selections of the Nanking cherry (*Prunus tomentosa*) and of hardy Russian cherries from the Vladimir district appear very promising as hardy cherries for the future, but named varieties are not at present on the market.

GRAPES

Only a few of the hardiest varieties of grapes are suitable for growing on the northern Plains, and all grapes except seedlings of the hardy native grapes will require covering during the winter.

Beta, Suelter, Alpha, and Monitor have produced some fruit at the Northern Great Plains Field Station. The Beta has been widely



FIG. 22.—Sapa plums in the foreground badly killed back in the winter of 1924-25, while Opatas in the row to the left escaped injury. Photographed at the Northern Great Plains Field Station in June, 1925.

grown and will thrive if any variety will. However, grapes are not generally recommended for the home fruit garden on the northern Plains.

SMALL FRUITS

Such small fruits as currants and gooseberries are, next to plums, the hardiest and most reliable fruits for the northern Plains. They should be included in every home fruit garden.

Currant varieties that have done well at the Northern Great Plains Field Station include London Market, Red Dutch, Pomona, Perfection, and White Grape. The first three are red currants which have been very hardy and are heavy annual bearers. Perfection

has not been so hardy or so prolific as the others mentioned, but the berries and clusters are large and easy to pick. White Grape may be added if a white variety is desired. Figure 24 shows London Market currants apparently uninjured after the winter of 1924-25, whereas Cherry currants in an adjacent row were killed back almost to the ground.

European black currant (*Ribes nigrum*) varieties are not recommended, because they are extremely susceptible hosts for white-pine blister rust.⁵ In Montana it is unlawful to possess or sell these plants, and the United States Department of Agriculture is opposed to their being grown anywhere in the United States, since they constitute a menace to the white-pine forests.

Gooseberries as a class are not such hardy or reliable bearers as currants, but they generally do very well and have their place in the home fruit garden. Houghton and Carrie are recommended for general planting, and Oregon, Poorman, Van Fleet, and Como are suggested for trial.

Houghton has been the hardiest and most prolific gooseberry under trial. It is a red variety of small size but good quality.

The Carrie gooseberry is similar to Houghton in color, size, and quality. It is among the hardest, is generally prolific, and is easy to pick because of its relative freedom from thorns and of the position of the berries. (Fig. 25.)

The Oregon variety has not been hardy at Mandan. It is a large green gooseberry, rather sour but of fair to good quality, and is suggested for trial under favorable conditions. Figure 26 shows Oregon gooseberries killed to the ground in the winter of 1924-25, when Houghton gooseberries in an adjacent row were not injured.

Poorman has not been tested long enough at the Northern Great Plains Field Station to warrant a statement of its merits. It has done very well in some sections and is believed to be worthy of trial.

Van Fleet has been fairly hardy at Mandan. The fruit is large, dark red, sweet, and of very good quality. The bushes are thorny, but it is believed to be of value because of its large sweet fruit.

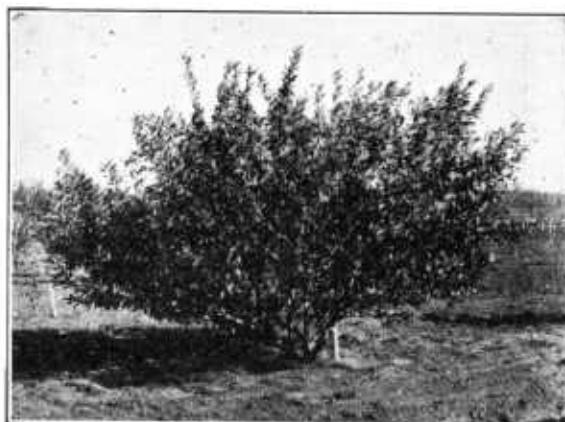


FIG. 23.—Compass, one of the hardest and most prolific of the plum \times sand-cherry hybrids. Photographed at the Northern Great Plains Field Station in August, 1925.

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The Oregon variety has not been hardy at Mandan. It is a large green gooseberry, rather sour but of fair to good quality, and is suggested for trial under favorable conditions. Figure 26 shows Oregon gooseberries killed to the ground in the winter of 1924-25, when Houghton gooseberries in an adjacent row were not injured.

Poorman has not been tested long enough at the Northern Great Plains Field Station to warrant a statement of its merits. It has done very well in some sections and is believed to be worthy of trial.

Van Fleet has been fairly hardy at Mandan. The fruit is large, dark red, sweet, and of very good quality. The bushes are thorny, but it is believed to be of value because of its large sweet fruit.

⁵ All currant and gooseberry (*Ribes*) plants are hosts of white-pine blister rust, a destructive disease of five-leafed pines. The invasion of North America by the white-pine blister rust has brought about laws and quarantines prohibiting or regulating the shipment of currant and gooseberry plants in order to control the disease. For this reason persons desiring to ship currant and gooseberry plants should consult the State nursery inspector as to legal restrictions.

Como is a new product of the Minnesota State Fruit-Breeding Farm and has not yet been tested at the Northern Great Plains Field Station, but because of the favorable reports where it has been tested it is considered desirable for trial.

Raspberries are neither hardy nor drought-resistant enough to be adapted for general planting in the dry-land fruit gardens of the northern Plains. If grown they should be covered with soil in the winter and if possible irrigated. Loudon, King, Herbert, Latham, and Sunbeam have yielded light crops at the Northern Great Plains Field Station in favorable years, but all varieties have failed in dry years. Sunbeam is one of the hardiest and most drought resistant, and Latham produces the finest fruit. Black raspberries have yielded even less than the red varieties.



FIG. 24.—London Market currants at the left, uninjured in the winter of 1924-25 at the Northern Great Plains Field Station, and Cherry currants at the right, killed almost to the ground. Photographed in June, 1925

Strawberries do well in the home fruit garden if irrigated. If not, it is doubtful if they have a place there, as the crop is often a failure under dry-land conditions. Dunlap and South Dakota have been the best yielders of the better known June bearing varieties, and Nokomis is recommended for trial. Of the everbearing varieties, Progressive and Duluth are suggested for testing.

NATIVE FRUITS

A number of hardy native fruits are to be found in protected coulees and along streams throughout a large part of the northern Plains area. People often drive long distances to pick such fruits and occasionally transplant young bushes from the wild to their yards or grow seedlings from particularly good wild plants.

Plums are of first importance among the native fruits, *Prunus americana* being the species common on the northern Plains. Named varieties of native plums have already been discussed. The wild fruit is used for canning, jam, sauce, plum butter, jelly, and for eating out of hand.

The western sand cherry (*Prunus besseyi*) is not gathered so much in the wild as are some other native fruits. It seems to respond very readily to cultivation, both fruit and bush becoming much larger than they are ordinarily found in the wild state. Several varieties have been named, of which Sioux and Champa have been the best of those tested at the Northern Great Plains Field Station. These varieties have been hardy, drought resistant, and usually



FIG. 25.—A 3-year-old Carrie gooseberry loaded with fruit at the Northern Great Plains Field Station in August, 1922

prolific, so they are of value for the home fruit garden. Sioux ripens earlier than any plum, is sweet and mild in flavor, and is good for pies or sauce. Champa may have some plum blood in it and belong in the plum \times sand-cherry hybrid class, but it is a dwarf bush and so may be treated as a sand cherry. It appears to be hardy and prolific. Figure 27 shows a fruiting branch of a sand-cherry selection.

The common wild chokecherry (*Prunus virginiana*) is much sought after in the wild state because of the excellent jelly and jam which this fruit makes. Some so-called chokeless selections have been made and have had a limited sale on the market, but there are few if any named varieties of this fruit. Chokecherries may be used for an outside or inside row of the shelter belt and may thus

furnish both fruit and shelter. Figure 28 illustrates fruiting branches of the native chokecherry and shows its heavy production.

Native buffalo berries (*Shepherdia argentea*) also make good jelly, although it is of light color and not so clear as some other fruit jellies. These berries are frequently gathered in the wild, being knocked from the tree on to blankets spread to catch them. But little work has been done to improve the buffalo berry, and it is not often grown under cultivation for its fruit. Like the chokecherry and the plum, it may be used for an outside or inside row of the shelter belt, where it will be of use for both shelter and fruit.

June berries or service berries (*Amelanchier alnifolia*, *A. alnifolia pumila*, and *A. canadensis*) are native to the region and are often



FIG. 26.—Oregon gooseberries at the right, killed back to the ground in the winter of 1924-25, and Houghton gooseberries at the left, uninjured. Photographed at the Northern Great Plains Field Station in June, 1925.

gathered from wild plants, the fruit being used for pies and sauce. The flavor is a little flat; hence currants or rhubarb are often mixed with June berries with very good results. The only named variety of June berry tested at the Northern Great Plains Field Station is Success. It is of fair size and quality, hardy, and generally prolific. It has done very well and deserves a place in the home fruit garden. Selection and breeding work with June berries is in progress at the station.

The fruit of the native American cranberry bush (*Viburnum americanum*) is desirable for jelly. Some superior selections of this fruit have been made by Mrs. Fanny Heath of Grand Forks, N. Dak., and by the North Dakota Agricultural Experiment Station.

Golden or yellow flowering currants (*Ribes odoratum*) (fig. 29) are sometimes picked in the wild and are grown for fruit and orna-

mental purposes. They make very good jelly, and some persons like them in pies. A number of promising selections have been made at the Northern Great Plains Field Station, and the best of these are thought to be well worth planting in the home fruit garden of the northern Plains. They are very hardy, drought resistant, and reliable yielders. An objection is the uneven ripening of the fruit.

Among other native fruits may be mentioned the American black currant (*Ribes americanum*), which is useful for jelly; the native grape (*Vitis vulpina*), which is often gathered for making jelly or grape juice; and native gooseberries, raspberries, strawberries, hawthorns, and hazelnuts.



FIG. 27.—Native sand-cherry (*prunus besseyi*) selection at the Northern Great Plains Field Station in August, 1925

PLANTING PLAN FOR THE HOME FRUIT GARDEN

Every farmer should make a planting plan of his fruit garden, so that he will have no difficulty in distinguishing the different varieties when they reach a bearing age and will be able to draw conclusions as to which varieties are adapted to his locality.

Figure 30 is an example of such a plan. Such details as the size and shape of the fruit garden, the varieties selected, and the distances of planting will vary with the different conditions of each farm. In the plan shown, rows of apples and crabs are 25 feet apart, rows of plums and plum hybrids 20 feet apart, and rows of small fruits 10 feet apart. The row of American cranberry bushes and June berries is spaced 15 feet from the row of plum hybrids on one side and 10 feet from the row of small fruits on the other. Apples and crabs are spaced 25 feet apart in the row; plums 15 feet; plum \times sand-cherry hybrids 12 feet; sand cherries, June berries, American

cranberry bushes, Golden currants, and grapes 6 feet; and raspberries, gooseberries, and currants 4 feet apart.

The following planting list for a farm fruit garden of about an acre is suggested for well-protected sites in those districts on the northern Plains that have a comparatively long growing season. The rows are numbered from south to north and the varieties listed from east to west in the rows:

Row 1.—1 Florence crab, 2 Virginia crabs, 2 Whitney crabs, 2 Transcendent crabs.

Row 2.—1 Florence crab, 2 Hibernal apples, 2 Oldenburg apples, 2 Wealthy apples.

Row 3.—2 Red Wing plums, 3 Terry plums, 2 Waneta plums, 2 Wolf plums, 2 Emerald plums.



FIG. 28.—Native chokecherry (*Prunus virginiana*) selection at the Northern Great Plains Field Station in August, 1922

Row 4.—4 Sioux sand cherries, 4 Champa sand cherries, 3 Compass plum \times sand-cherry hybrids, 3 Opata plum \times sand-cherry hybrids, 3 Sapa plum \times sand-cherry hybrids.

Row 5.—9 Success June berries, 5 Dwarf or other June berries, 12 American cranberries.

Row 6.—10 Golden currants, 10 Beta grapes, 6 Alpha grapes.

Row 7.—9 London Market currants, 8 Perfection currants, 8 White Grape currants, 5 Houghton gooseberries, 5 Carrie gooseberries, 5 Van Fleet gooseberries.

Row 8.—20 Herbert raspberries, 20 King raspberries.

Row 9.—20 Latham raspberries, 20 Sunbeam raspberries.

Strawberries or garden crops may be grown in the space between the fruit trees and the shelter belt for several years, especially if water for irrigating is available. Such crops should not be planted closer than 10 feet to fruit or shelter-belt trees.

If the site of the proposed fruit garden is not very well sheltered, or if the district has an unusually severe climate or a comparatively short growing season (for the northern Plains), changes in the suggested variety list will be necessary. For such conditions the following varieties are suggested for trial:

Apples.—None.

Crabs.—Dolgo, Silvia, Transcendent, Virginia, and Red (or Yellow) Siberian.

Plums and plum hybrids.—Assiniboine, Opata, Compass, Cree, Ojibwa, Teton, Wyant, and Wolf.

Grapes.—None.

June berries.—Success and some others for cross-pollination.

Sand cherries.—Sioux and Champa.



FIG. 29.—Native golden-currant (*Ribes odoratum*) selection at the Northern Great Plains Field Station. Photographed August 1, 1922.

Currents.—London Market, Pomona, Red Dutch, and White Grape.

Gooseberries.—Carrie and Houghton.

Raspberries.—None.

Native fruits.—Golden currants, American cranberry bushes, chokecherries, and others.

SUMMARY AND RECOMMENDATIONS

Fruit growing for home use is of decided importance on the northern Great Plains, because it makes farm homes more attractive and the population more permanent and contented.

Because of climatic limitations it is not easy to grow good fruit in this area; but experience indicates that if a suitable site is chosen, hardy varieties planted, and the plants given proper care, the northern Plains farmer will be well repaid for his efforts in this direction.

The site should be nearly level or sloping toward the north or northeast; good air drainage is desirable; at least fairly good soil

should be chosen; a location close to farm buildings is most convenient; and the site should be sheltered from west, south, and north winds.

Prepare the land well by either fallowing or growing a cultivated crop the year before fruit trees are planted.

Order first-class 1-year-old or 2-year-old trees from a reliable northern nursery.

Take special care that the roots are not allowed to dry out at any time.

In planting, pack moist soil carefully and firmly around the roots.

If proper shelter is available, plant at standard distances. If the site is exposed to winds it may be better to plant trees closely in rows

SHELTER BELT

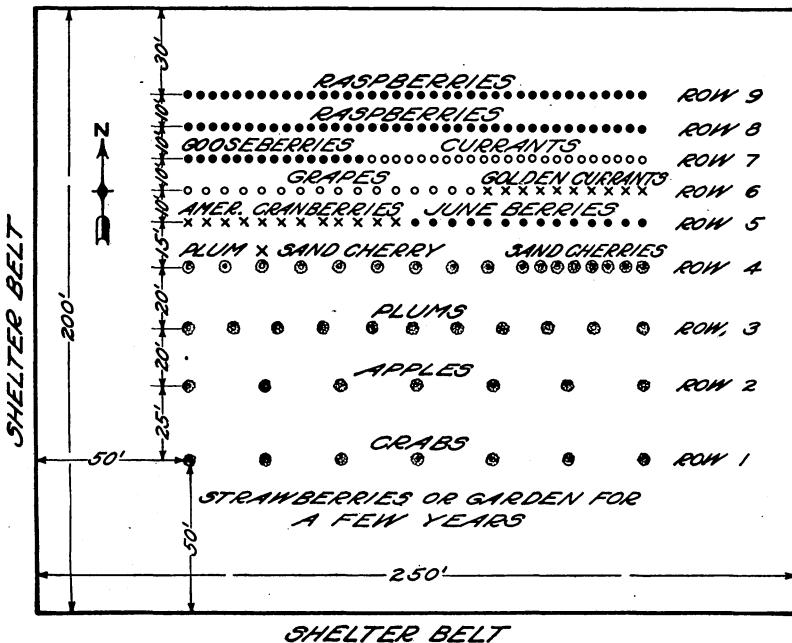


FIG. 30.—Planting plan for a home fruit garden of about an acre

or to plant in groups so that they can protect one another and hold the snow. The fruit trees should be at least 30 feet from the shelter-belt trees.

Practice clean cultivation throughout the spring, summer, and early fall. Add manure to keep up the supply of humus. A cover crop is of doubtful value under dry-land conditions as it uses moisture needed by the trees.

Do not plant an intercrop after the first few years, and not even then unless wide spacing is used.

Irrigation is desirable in the home fruit garden, but it is not necessary. It is of special value for small fruits such as strawberries and raspberries. A late-fall irrigation, after dry seasons, may tend to prevent winter injury.

Prune the orchard to develop a low-headed or even a bush type of tree. Develop a strong tree framework in the early years, and practice a light annual thinning out of superfluous branches after the trees reach a bearing age.

Thin the fruit at an early stage, as overbearing results in inferior fruit, causes broken branches, and weakens the tree, making it more susceptible to winter injury.

Spray each year at the proper time.

Protect the trees from rabbits and mice.

Cover strawberries with 6 inches of clean straw during the winter, cover raspberries and grapes with soil, and give some form of winter protection to young fruit trees.

The hardier varieties of apples, crabs, plums, plum \times sand-cherry hybrids, sand cherries, June berries, currants, gooseberries, raspberries, strawberries, native fruits, and perhaps a few of the harder varieties of grapes can be grown with a greater or less degree of success, depending on the district, the site, and the care given the plants. Peaches, pears, apricots, quinces, cherries, grapes, blackberries, dewberries, and nuts are not generally hardy, and their planting can not be advised.

Make a selection of varieties so as to have fresh fruit on the table over a comparatively long time in the summer and fall.

Plant two or more varieties of each kind of fruit, as many varieties are self-sterile.

A planting plan of the fruit garden should always be made, so that there will be no difficulty in identifying the different varieties at any time.

SOURCES OF ADDITIONAL INFORMATION

The fruit grower or prospective fruit grower should join the horticultural society of his State. Much information may be obtained at the meetings and from the reports and publications of these societies.

Information and bulletins on the various phases of fruit growing may be obtained from the State agricultural experiment stations at Bozeman, Mont.; Fargo, N. Dak.; Brookings, S. Dak.; and Laramie, Wyo.

The following Farmers' Bulletins may be obtained free as long as the supply lasts. Make your request to your Senator or Representative in Congress or direct to the Department of Agriculture, Washington, D. C.

- 181-F. Pruning.
- 471-F. Grape propagation, pruning, and training.
- 702-F. Cottontail rabbits in relation to trees and farm crops.
- 727-F. Growing fruit for home use in the Great Plains area.
- 864-F. Practical information for beginners in irrigation.
- 887-F. Raspberry culture.
- 900-F. Homemade fruit butters.
- 901-F. Everbearing strawberries.
- 908-F. Information for fruit growers about insecticides, spraying apparatus, and important insect pests.
- 1001-F. Growing fruit for home use.
- 1027-F. Strawberry culture; Western United States.
- 1043-F. Strawberry varieties in the United States.

- 1096-F. Frost and the prevention of damage by it.
- 1128-F. Control of aphids injurious to orchard fruits, currant, gooseberry, and grape.
- 1178-F. Tree surgery.
- 1220-F. Insect and fungous enemies of the grape.
- 1242-F. Permanent fruit and vegetable gardens.
- 1250-F. Green manuring.
- 1270-F. The more important apple insects.
- 1286-F. The red-necked raspberry cane-borer.
- 1312-F. Tree planting in the Great Plains region.
- 1369-F. Bridge grafting.
- 1397-F. Mouse control in field and orchard.
- 1398-F. Currants and gooseberries: Their culture and relation to white-pine blister rust.
- 1405-F. The windbreak as a farm asset.
- 1458-F. Strawberry diseases.

The following bulletins are for sale by the Superintendent of Documents, Government Printing Office, Washington, D. C.:

Development of cooperative shelter belt demonstrations on the northern Great Plains. (Department Bulletin 1113-D.) Price 10 cents.

Report of the Northern Great Plains Field Station for the 10-year period, 1913-1922, inclusive. (Department Bulletin 1301-D.) Price 15 cents.

Work of the Northern Great Plains Field Station in 1923. (Department Bulletin 1337-D.) Price 5 cents.

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